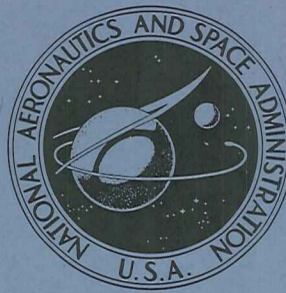


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DEPLOYMENT LOADS DATA FROM
A FREE-FLIGHT INVESTIGATION OF
ALL-FLEXIBLE PARAWINGS AT SMALL SCALE

by Delwin R. Croom

Langley Research Center

Hampton, Va. 23365

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • AUGUST 1971

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16. Abstract <p>A free-flight investigation to determine the deployment characteristics of all-flexible parawings was made at the Joint Parachute Test Facility, El Centro, California, under NASA contract NAS 1-7467. Both single-keel and twin-keel parawings having wing areas of 37.16 m² (400 sq ft) with a five-stage reefing system were tested by use of a bomb-type instrumented test vehicle. The system was launched from either a C-130 or a B-66 carrier aircraft and a programer parachute was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight path prior to deployment of the parawing system. This paper presents without discussion the free-flight deployment loads data obtained under this contract in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads.</p>					
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DEPLOYMENT LOADS DATA FROM A FREE-FLIGHT INVESTIGATION OF ALL-FLEXIBLE PARAWINGS AT SMALL SCALE

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SUMMARY

A free-flight investigation of all-flexible parawings was made at the Joint Parachute Test Facility, El Centro, California, under NASA contract NAS 1-7467. This paper presents without discussion the free-flight deployment loads data that were obtained under this contract on single-keel and twin-keel parawings with wing areas of 37.16 m^2 (400 sq ft). These data are presented in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads.

INTRODUCTION

The NASA has been investigating all-flexible fabric wings to define and evaluate their performance stability, control, and deployment characteristics. References 1 to 6 report the results of wind-tunnel investigations of several single-keel and twin-keel parawing configurations. Reference 7 reports the highlights of a wind-tunnel and free-flight investigation of all-flexible parawings at small scale that was obtained under NASA contract NAS 1-7467.

The purpose of the present paper is to document all the free-flight deployment loads data obtained under contract NAS 1-7467 on parawings having wing areas of 37.16 m^2 (400 sq ft). These data are presented without discussion and are in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads.

SYMBOLS

Measurements were taken in the U.S. Customary System of Units. Values are indicated both in the International System (SI) and in the U.S. Customary System of units.

a_x, a_y, a_z longitudinal, lateral, and vertical accelerations, respectively, g units

b_0 parawing flat-pattern span, m (in.)

$C_{F,t}$	total force coefficient, F_t/qS
F	force, N (lb)
F_t	total force, N (lb)
h	altitude above mean sea level, m (ft)
h_{PD}	altitude above mean sea level at programmer parachute disconnect, m (ft)
l_k, l_{le}	flat-pattern length of keel and leading edge, respectively, m (in.)
l_r	effective reefing-line length, including end attachments for noncontinuous reefing lines, m (in.)
l_r/l_k	effective reefing ratio
q	dynamic pressure, N/m^2 (lb/ft ²)
q_{PD}	dynamic pressure at programmer parachute disconnect, N/m^2 (lb/ft ²)
S	flat-pattern parawing area, m ² (ft ²) ($0.69148l_k^2$ for single-keel wings; $0.7726l_k^2$ for twin-keel wings)
$t_{PD}, t_{LS}, t_{1DR},$ t_{2DR}, t_{3DR}, t_{LT}	time in seconds after launch for events of programmer parachute disconnect, line stretch, first disreef, second disreef, third disreef, and line transfer, respectively
V	velocity, m/sec (ft/sec)
W_D	descent weight, N (lb)
W_P	suspended weight, N (lb)
x, y, z	body axes
x_k, x_{le}, x_{te}	distance along keel, leading edge, and trailing edge, respectively, m (in.)
γ	flight-path angle, measured positive downward from horizontal, deg

Suspension-line designation:

le,te,k leading edge, trailing edge, and keel line, respectively. Prefixes L and R indicate left side and right side, and numbers 1 to 12 indicate the canopy attachment location

Reefing-line designation:

For single-keel parawing:

1r reefing line around right lobe
2r reefing line along keel
3r reefing line along trailing edge

For twin-keel parawing:

Cr reefing line around center lobe
Lr reefing line around left lobe
Rr reefing line around right lobe
ter reefing line along trailing edge

DESCRIPTION OF PARAWINGS

Flat-pattern planform drawings of the single-keel and twin-keel parawings are shown in figures 1 and 2, respectively. The model dimensions and suspension-line-attachment locations are also shown in these figures. Figures 3 to 5 show construction details and materials used in construction of the parawings. Measured preflight suspension-line lengths for each test are given in tables I and II for the single-keel and twin-keel parawings, respectively.

PARAWING REEFING SYSTEM

General

A parawing deployment program was conducted in the Langley full-scale wind tunnel (reported in ref. 7) to provide information relevant to the design of a hypothetical full-scale parawing recovery system for a 66 720 N (15 000 lb) spacecraft with the following deployment requirements:

- (a) Deployment altitude range of 915 to 5485 meters (3000 to 18 000 ft)
- (b) Dynamic pressure at deployment initiation of 1436 to 4788 N/m² (30 to 100 lb/ft²)
- (c) The maximum load imparted to the payload under any deployment condition not to exceed 3g including the 1g gravitational force.

It was determined from the wind-tunnel results that a multistep drag-area capability would be necessary to meet the foregoing deployment requirements. The reefing systems selected for the single-keel and the twin-keel parawing free-flight deployment tests are described in the following paragraphs.

Single-keel reefing system.- All suspension lines were shortened in stage 1 to the length of the shortest suspension line (the wing-tip lines). Making all suspension lines the same length eliminated loose lines which could become entangled during the deployment process. It also prevented damage to the keel suspension lines from abrasion against the skirt reinforcing band of the wing.

The canopy was reefed into two lobes by gathering the trailing edges and routing the single-stage reefing lines around the leading edges, trailing edges, and each side of the keel. Figure 6 shows a view of the canopy from below during stage 1. As can be seen, two lobes are formed, the keel forming the partition between the lobes. For a range of reefing-line ratios l_r/l_k from approximately 0.15 to 0.25, the drag coefficient of the fully inflated reefed wing was relatively constant. (See ref. 7.) The ability to vary the reefing-line length without varying the steady-state drag coefficient is desirable in that it allows the first-stage filling time to be varied without reducing the first-stage drag coefficient.

Stage 2 was the same as stage 1, except that the length of the reefing lines was increased to give a higher drag coefficient by means of the first-stage reefing cutters. Figure 6 shows a view of the canopy from below during second stage.

For stage 3 the leading-edge and keel reefing lines were severed by the second-stage reefing cutters; as a result, all the suspension lines were left equal in length and the trailing edges were still gathered. Figure 6 shows the appearance of the third stage from below. The gathering of the trailing edges is evident, as shown by the rounded shape of the trailing-edge part of the canopy. The trailing edges were gathered by routing a line through reefing rings from wing tip to wing tip and then pulling the line taut. This reefing method brought each wing tip up next to the keel and gathered all the trailing-edge skirt band between the wing tips. In this stage the wing made the transition from a parachute-like drag device to a gliding wing. The glide direction during this stage was rearward.

For stage 4 the trailing-edge gathering line was released by the third-stage reefing cutters and the wing was allowed to inflate fully. The wing continued to glide rearward during this stage. Figure 6 shows a view of the canopy from below during fourth stage. The suspension lines along the trailing edge were needed to provide stable canopy inflation and flight stability during the fourth reefed stage.

For stage 5 the foreshortened suspension lines were released by a swing arm to go to the correct lengths for gliding flight. After the change in suspension-line lengths, the wing underwent a transition to forward gliding flight. The trailing-edge lines were lengthened sufficiently to become slack during the gliding phase.

Twin-keel reefing system.- For stage 1 all suspension lines were shortened to the length of the shortest (tip) line. This shortening was done for the reason previously discussed for the single-keel reefing system. The wing surface was reefed into three lobes by use of a reefing line around the periphery of each section of the wing (that is, the center and two side panels) and by gathering the trailing edges. This reefing method provided three separate inlets through which air entered for inflation. The inlets were separated from each other by the keels. Figure 7 shows a view of the canopy from below during stage 1. The variation of drag coefficient with reefing-line ratio was the same for both the twin- and single-keel wings. (See ref. 7.) As previously stated in the discussion of the single-keel reefing system, the relatively constant drag coefficient over a range of reefing-line ratios allowed control of filling time and still provided a stable inflated shape; thereby control of the opening forces experienced during stage 1 was allowed and sufficient drag area was provided to give a relatively low terminal velocity for the first reefed stage.

For stage 2 the reefing lines in the side panels of the wing were severed by the first-stage reefing cutters; as a result, the leading edges of the side panels were allowed to inflate fully. The center lobe remained reefed as in the first stage. The resulting inflated planform is shown in figure 7. This stage continued to act as a drag device similar to a parachute.

For stage 3 the center-section reefing line was severed by the second-stage reefing cutter. The wing planform in this stage is shown in figure 7. The trailing edges remained gathered as described for the single-keel reefing system. During this stage the wing went into rearward gliding flight.

For stage 4 the trailing-edge gathering line was severed and the wing was allowed to inflate fully. The wing underwent a transition to forward gliding flight in this stage.

For stage 5 the suspension lines were released to their gliding flight lengths and the wing made a transition to gliding flight.

Modifications to Initial Reefing System

The first deployment test of each of the single-keel and the twin-keel designs was made with the reefing system selected from the full-scale wind-tunnel investigations (reported in ref. 7); however, as the flight program progressed, changes in the reefing system were found to be necessary for various reasons. The following paragraphs describe the various versions of the reefing systems that were flight tested.

Single-keel reefing system, version I.- In stage 1 all suspension lines were rigged to a length equal to the length of the tip suspension lines. The trailing edges were gathered and a two-stage reefing line was routed around each side of the wing. The extra length of the second-stage reefing line was stored in a long loop as shown in figure 8. The reefing lines ran along the keel and the leading edges to form two separate lobes.

Figure 8 shows the layout of the reefing lines with the wing reefed for the first stage. The disreef sequence was as follows:

- (1) First-stage reefing line cut to allow inflation to the limits of the second-stage reefing lines
- (2) Second-stage reefing lines cut to free the leading edges and keel
- (3) Trailing-edge gathering line cut to allow full inflation of the canopy
- (4) Suspension lines released to flying configuration lengths.

Single-keel reefing system, version II.- In stage 1 all suspension lines were rigged to a length equal to the length of the tip suspension lines. The trailing edges were gathered, the keel was gathered by attachment of the reefing line to the front keel-line-attachment loop (see fig. 9), and single-stage reefing lines were run along each leading edge to form two separate lobes.

Figure 9 shows the layout of the reefing lines with the wing reefed for first stage. The disreef sequence was as follows:

- (1) First-stage reefing lines cut to free leading edges of the wing (keel and trailing edges remained constrained)
- (2) Second-stage reefing lines cut to free the keel
- (3) Trailing-edge gathering line cut to allow full inflation of the canopy
- (4) Suspension lines released to flying configuration lengths.

Single-keel reefing system, version III.- In stage 1 all suspension lines were rigged to a length equal to the length of the tip suspension lines. The left and right lobes were reefed separately with a single-stage reefing line. The trailing edges were gathered by a reefing line attached to each tip line attachment loop. The keel and leading edge from the front end of the keel to the second leading-edge suspension line on each side were gathered. Reefing lines were run from the second leading-edge line through the reefing ring at the tip suspension line on each side of the canopy and terminated at the aft keel suspension line. Figure 10 shows the layout of the reefing lines with the wing reefed for first stage. The disreef sequence was as follows:

- (1) The first-stage reefing lines cut by the first-stage cutter to allow the leading edges from the second suspension line to the tip to inflate on each side (the

leading edges from the front end of the keel to the second suspension line on each side, the keel, and the trailing edges remained constrained)

- (2) Second-stage reefing lines cut by the second-stage cutter to release the leading edges and keel
- (3) Trailing-edge gathering line released by the third-stage cutters to allow full inflation of the canopy
- (4) Suspension lines released by the swing arm to the flying configuration lengths.

Twin-keel reefing system, version I.- In stage 1 all suspension lines were rigged to a length equal to the length of the tip suspension lines. The trailing edges were gathered by a reefing line attached to the two wing tips, and three separate single-stage reefing lines were routed around the leading edges and keels to form three separate lobes. Figure 11 shows the layout of the reefing lines for stage 1. The disreef sequence was as follows:

- (1) First-stage reefing lines cut by the first-stage cutter to free the leading edges of the two outboard lobes; the center lobe remained reefed
- (2) The second-stage reefing line cut by the second-stage cutter to free the leading edge and keels of the center lobe
- (3) Trailing-edge gathering line cut by the third-stage cutter to allow the canopy to inflate completely
- (4) Suspension lines released by the swing arm to the flying configuration lengths.

Twin-keel reefing system, version II.- In stage 1, the reefing system was the same as that used in reefing version I. The difference between reefing versions I and II was in the disreef sequence. The disreef sequence for reefing version II was as follows:

- (1) First-stage reefing lines cut to free the leading edges of the two outboard lobes; the keel and trailing edges remained constrained
- (2) The second-stage reefing line was cut to free the leading edge and keels of the center lobe
- (3) Suspension lines released to flying configuration lengths
- (4) Trailing-edge gathering line cut to allow the canopy to inflate completely.

TEST VEHICLE AND INSTRUMENTATION

A bomb-type test vehicle was used in the reefed deployment tests at El Centro, California. It consisted of a cylindrical structure with a flared external aft section and a removable conical nose. The vehicle was designed for launch from either a C-130 or a B-66 carrier aircraft. Launches from a C-130 were made from the rear of the cargo

compartment with the aid of an inclined ramp. B-66 launches were made from the bomb bay by use of launch lugs mounted on the center line of the test vehicle. Large variations in vehicle weight were obtained by attaching ballast bars externally. Smaller adjustments were made by adding lead shot to ballast compartments in the vehicle nose. The vehicle contained a compartment in the aft end to accommodate the packed parawing, programer parachute, pyrotechnically operated programer parachute disconnects, high-speed motion-picture camera, and system safety switches. The forward section of the test vehicle contained a telemetry (TM) and sequencer module. By removing the vehicle nose, the sequencer and TM module could be extracted for checkout and resetting. A schematic of the bomb-type test-vehicle external envelope is shown in figure 12.

Instrumentation used in the deployment tests included a total load link which measured the total loads applied to the test vehicle by the parawing model, linear accelerometers to measure acceleration felt by the test vehicle along the three vehicle body axes, and load links to measure individual suspension-line loads. A schematic of the load links is included in figure 12 to show where they were located. In certain of the tests, reefing-line load links were mounted in the parawing model and their output read in lieu of the output from certain of the accelerometers. Table III is a summary of the onboard data measurements for each test. The information measured by the different sensors was telemetered to a ground receiving station and recorded on magnetic tape.

In addition to the telemetered information, an onboard camera recorded the parawing deployment and opening section of the flight. Air-to-air and ground-to-air motion-picture coverage of the flight was also obtained. These films were used in conjunction with the TM and onboard camera data to obtain event times plus qualitative information on parawing deployment and inflation behavior. Trajectory parameters such as dynamic pressure, flight-path angle, and so forth, were obtained from Askania phototheodolite space measurements. These Askania data were corrected for winds.

TEST PROCEDURE

A programer parachute was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight-path angle prior to deployment of the parawing test model. A typical test began with deployment of the programer parachute by a static line upon launch from the drop aircraft. After a predetermined time interval required to achieve the desired test conditions, an onboard electronic sequencer actuated pyrotechnic devices which disconnected the programer parachute. The disconnected programer parachute, in turn, deployed the parawing. Figure 13 illustrates a typical test sequence.

Single-Keel Parawing Deployment Tests

The first two deployment tests with the single-keel parawing were verification tests at El Mirage Dry Lake and test 104S at El Centro. The reefing method used for these tests was the single-keel reefing version I. During both of these tests, a mechanical problem was encountered in deploying the stowed part of the second-stage reefing lines. Subsequent bench tests showed that the first-stage reefing line was being inadvertently locked in place by the bunching of reefing rings along the keel. This arrangement prevented reefing-line payout when the reefing-line cutters fired. To solve this problem, reefing version II was devised.

Tests 102S and 103S were conducted with reefing version II. This reefing method gave satisfactory operation except that the second- and third-stage opening loads were not balanced. The second-stage loads were higher than desired, and the third-stage loads were lower than the maximum allowable. Therefore, reefing version III was adopted and employed in tests 101S and 100S. Although this reefing method was marginally successful in reducing the second-stage loads, there was an unacceptable increase in third-stage loads. Also, reefing version III produced a longitudinal pitch oscillation during the second stage. With this method of reefing, the two lobes formed during stage 2 could inflate unsymmetrically. This asymmetric inflation in turn induced a spin and attendant problems in the transition to stage 3 of the reefing sequence. Therefore, this reefing version was abandoned and version II was used for the remainder of the single-keel deployment tests.

Twin-Keel Parawing Deployment Tests

The first twin-keel deployment test was conducted at the El Mirage Dry Lake test site to verify proper functioning of the reefing system. For this test, twin-keel reefing version I was used. During this test, two anomalies were noted. The first was an aerodynamic stability problem. During fourth stage the wing attempted to glide forward at a low angle of attack that caused the nose to collapse. It appeared that canopy inversion or, at best, extremely unstable canopy inflation would occur by using the version I fourth-stage configuration. The second anomaly was attributed to a misrigging of the line-transfer mechanism which prevented suspension-line transfer on one side of the wing. Otherwise, inflation behavior and functioning of the reefing system was satisfactory for the first three stages of reefing.

Because of the instability during stage 4 with reefing version I, reefing version II was used for subsequent test 102T and 104T. Reefing version II was identical to reefing version I, except that the times of activation for stage 4 and line transfer were interchanged. The intent was to achieve stability during the fourth stage of the reefing

sequence. During test 102T, however, stage 4 and line transfer occurred so close together that the stability during stage 4 could not be evaluated.

During test 104T, using reefing version II, staging occurred at the planned time intervals; however, this reefing configuration was unstable during the fourth stage. To solve this problem, reefing version I was reinstated with the addition of trailing-edge lines on the outer lobes to stabilize canopy inflation during stage 4. This reefing method was used successfully for all the remaining twin-keel deployment tests.

REDUCTION OF DATA

The altitude, flight-path angle, and velocity relative to the ground were obtained from the phototheodolite tracking data. The movement of the ambient air relative to the ground and the atmospheric density were obtained by rawinsonde balloons. Wind corrections were applied to the velocity and dynamic pressures.

Onboard instrumentation provided force measurements which, when telemetered to the ground receiving station, were recorded on magnetic tape as a force time history of the flight.

In the data-reduction process, the analog data on the magnetic tapes were converted to a digital tape. The digital tape was then processed to convert the data to engineering units and then into coefficient form.

PRESENTATION OF DATA

The free-flight deployment loads data on parawings having wing areas of 37.16 m^2 (400 sq ft) that were obtained under NASA contract NAS 1-7467 are presented without discussion. These data are presented in figures 14 to 29 as time histories of individual suspension-line loads, reefing-line loads, and total loads. A detail listing of each component measured is given in table III and a summary of the test conditions and event times with comments on the tests extracted from reference 7 are given in table IV for the single-keel configuration and in table V for the twin-keel configuration.

CONCLUDING REMARKS

The free-flight deployment loads data obtained under NASA contract NAS 1-7467 for single-keel and twin-keel parawings with wing areas of 37.16 m^2 (400 sq ft) are

presented without discussion. These data are in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads.

Langley Research Center,
National Aeronautics and Space Administration,
Hampton, Va., June 1, 1971.

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TABLE I.- DEPLOYMENT TEST PREFLIGHT SUSPENSION-LINE LENGTHS FOR SINGLE-KEEL PARAWING

(a) Lengths in meters												
Line	Suspension-line lengths for test --										Line	
	100S	101S	102S	103S	104S	105S	106S	107S				
Lle1	7.861	7.925	7.938	7.887	7.868	7.938	7.887	7.925				
Lle2	7.391	7.417	7.430	7.379	7.417	7.544	7.417	7.544				
Lle3	7.087	7.112	7.118	7.094	7.112	7.224	7.099	7.224				
Lle4	6.909	6.896	6.909	6.868	6.883	6.706	6.858	6.716				
Lle5	6.515	6.515	6.528	6.497	6.528	6.355	6.520	6.355				
Lle6	5.436	5.461	5.182	5.436	5.467	5.715	5.461	5.715				
Lte1	7.988	7.976	7.988	7.988	7.988	7.976	7.976	7.976				
Lte2	8.242	8.280	8.268	5.436	8.299	8.357	8.268	8.357				
Lte3	7.823	7.855	7.836	7.811	7.861	8.077	7.849	8.077				
Lte4	6.591	6.782	6.617	6.579	6.661	6.858	6.655	6.858				
k1	7.823	7.861	7.849	7.831	7.887	7.620	7.755	7.620				
k2	7.734	7.785	7.772	7.747	7.805	7.788	7.681	7.788				
k3	7.658	7.671	7.709	7.671	7.696	7.864	7.681	7.864				
k4	7.747	7.811	7.752	7.729	7.831	7.711	7.630	7.711				
k5	7.645	7.696	7.715	7.684	7.715	7.529	7.572	7.529				
k6	7.671	7.671	7.696	7.887	7.671	7.468	7.529	7.468				
k7	7.607	7.620	7.652	7.607	7.620	7.468	7.424	7.468				
k8	7.493	7.493	7.518	7.455	7.506	7.468	7.346	7.468				
k9	7.252	7.341	7.277	7.226	7.271	7.468	7.252	7.468				
k10	7.061	7.112	7.118	7.074	7.131	7.358	7.104	7.358				
k11	6.960	6.972	7.01	6.980	6.985	6.807	6.909	6.807				
k12	6.655	6.528	6.528	6.528	6.274	6.096	6.629	6.096				
Rle1	7.899	7.925	7.931	7.907	7.855	7.925	7.879	7.925				
Rle2	7.391	7.499	7.417	7.399	7.417	7.544	7.417	7.544				
Rle3	7.097	7.099	7.118	7.094	7.112	7.224	7.092	7.224				
Rle4	6.871	6.883	6.909	6.871	6.893	6.706	6.883	6.716				
Rle5	6.528	6.528	6.528	6.510	6.534	6.355	6.528	6.355				
Rle6	5.436	5.461	5.182	5.436	5.467	5.720	5.461	5.715				
Rte1	7.988	8.001	7.976	7.976	7.976	7.976	7.963	7.976				
Rte2	8.261	8.293	8.255	8.255	8.280	8.357	8.268	8.357				
Rte3	7.836	7.849	7.849	7.811	7.836	8.077	7.828	8.077				
Rte4	6.604	6.604	6.617	6.591	6.598	6.858	6.579	6.858				

(b) Lengths in inches												
Line	Suspension-line lengths for test --										Line	
	100S	101S	102S	103S	104S	105S	106S	107S				
Lle1	309.5	312.0	312.5	310.5	309.75	312.5	310.5	312.0				
Lle2	291.0	292.0	292.5	290.5	292.0	297.0	292.0	297.0				
Lle3	279.0	280.0	280.25	279.3	280.0	284.4	279.5	284.4				
Lle4	272.0	271.5	272.0	270.4	271.0	264.0	270.3	264.4				
Lle5	256.5	256.5	257.0	255.8	257.0	250.2	256.7	250.2				
Lle6	214.0	215.0	204.0	214.0	215.25	225.0	215.0	225.0				
Lte1	314.5	314.0	314.5	314.5	314.5	314.0	314.0	314.0				
Lte2	324.5	326.0	325.5	325.0	326.75	329.0	325.5	329.0				
Lte3	308.0	309.25	308.5	307.5	309.5	318.0	309.0	318.0				
Lte4	259.5	267.0	260.5	259.0	262.25	270.0	262.0	270.0				
k1	308.0	309.5	309.0	308.3	310.5	300.0	305.3	300.0				
k2	304.5	306.5	306.0	305.0	307.3	306.6	302.4	306.6				
k3	301.5	302.0	303.5	302.0	303.0	309.6	302.4	309.6				
k4	305.0	307.5	305.2	304.3	308.3	303.6	300.4	303.6				
k5	301.0	303.0	303.75	302.5	303.75	296.4	298.1	296.4				
k6	302.0	302.0	303.0	310.5	302.0	294.0	296.4	294.0				
k7	299.5	300.0	301.25	299.5	300.0	294.0	292.3	294.0				
k8	295.0	295.0	296.0	293.5	295.5	294.0	289.2	294.0				
k9	285.5	289.0	286.5	284.5	286.25	294.0	285.5	294.0				
k10	278.0	280.0	280.25	278.5	280.75	289.7	279.7	289.7				
k11	274.0	274.5	276.0	274.8	275.0	268.0	272.0	268.0				
k12	262.0	257.0	257.0	257.0	247.0	240.0	261.0	240.0				
Rle1	311.0	312.0	312.25	311.3	309.25	312.0	310.2	312.0				
Rle2	291.0	295.25	292.0	291.3	292.0	297.0	292.0	297.0				
Rle3	279.4	279.5	280.25	279.3	280.0	284.4	279.2	284.4				
Rle4	270.5	271.0	272.0	270.5	271.0	264.0	271.0	264.4				
Rle5	257.0	257.0	257.0	256.3	257.25	250.2	257.0	250.2				
Rle6	214.0	215.0	204.0	214.0	215.25	225.2	215.0	225.0				
Rte1	314.5	315.0	314.0	314.3	314.0	314.0	313.5	314.0				
Rte2	325.25	326.5	325.0	325.0	326.0	329.0	325.5	329.0				
Rte3	308.5	309.0	309.0	307.5	308.5	318.0	308.2	318.0				
Rte4	260.0	260.0	260.5	259.5	259.75	270.0	259.0	270.0				

TABLE II.- DEPLOYMENT TEST PREFLIGHT SUSPENSION-LINE LENGTHS FOR TWIN-KEEL PARAWING

(a) Lengths in meters

Line	Suspension-line lengths for test -							
	100T	101T	102T	103T	104T	105T	106T	107T
Lle1	6.297	6.388	6.502	6.447	6.439	6.601	6.388	6.449
Lle2	6.157	6.256	6.267	6.299	6.255	6.462	6.255	6.309
Lle3	6.020	6.129	6.217	6.167	6.414	6.325	6.123	6.172
Lle4	5.707	5.817	5.817	5.855	5.817	6.012	5.817	5.860
Lle5	5.118	5.342	5.423	5.398	5.398	5.560	5.340	5.245
Lle6	4.356	4.356	4.343	3.912	4.343	4.369	4.356	4.356
Lte1	7.290	7.442	----	7.468	----	7.239	7.442	7.442
Lte2	7.290	7.442	----	7.442	----	7.264	7.442	7.442
Lte3	6.350	6.515	----	6.502	----	6.318	6.515	6.502
Lk1	6.609	6.688	6.775	6.761	6.756	6.914	6.687	6.761
Lk2	6.713	6.744	6.737	6.853	6.744	7.018	6.744	6.863
Lk3	6.678	6.713	6.706	6.807	6.712	6.982	6.712	6.830
Lk4	6.609	6.650	6.648	6.731	6.648	6.914	6.648	6.761
Lk5	6.609	6.655	6.655	6.726	6.655	6.914	6.655	6.761
Lk6	6.609	6.650	6.655	6.726	6.648	6.914	6.648	6.761
Lk7	6.566	6.579	6.648	6.688	6.668	6.845	6.579	6.693
Lk8	6.541	6.586	6.572	6.680	6.585	6.845	6.458	6.693
Lk9	6.505	6.541	6.553	6.662	6.541	6.810	6.541	6.657
Lk10	6.434	6.472	6.548	6.591	6.471	6.739	6.471	6.586
Lk11	6.297	6.325	6.318	6.459	6.325	6.601	6.096	6.449
Lk12	6.299	6.350	6.712	6.624	6.623	6.601	6.350	6.449
Rk1	6.609	6.688	6.706	6.756	6.687	6.914	6.687	6.761
Rk2	6.713	6.731	6.756	6.858	6.731	7.023	6.731	6.866
Rk3	6.678	6.693	6.699	6.820	6.693	6.982	6.693	6.830
Rk4	6.609	6.642	6.629	6.769	6.642	6.914	6.642	6.761
Rk5	6.609	6.650	6.642	6.756	6.642	6.914	6.648	6.761
Rk6	6.609	6.642	6.642	6.756	6.642	6.914	6.642	6.761
Rk7	6.566	6.579	6.579	6.693	6.579	6.845	6.579	6.693
Rk8	6.542	6.586	6.566	6.706	6.585	6.845	6.585	6.693
Rk9	6.505	6.553	6.541	6.655	6.553	6.810	6.553	6.657
Rk10	6.434	6.464	6.471	6.591	6.464	6.739	6.464	6.586
Rk11	6.297	6.320	6.331	6.434	6.318	6.601	6.318	6.436
Rk12	6.299	6.350	6.604	6.629	6.585	6.601	6.350	6.449
Rle1	6.297	6.388	6.490	6.464	5.474	6.601	5.474	6.449
Rle2	6.157	6.256	6.261	6.299	6.255	6.462	6.255	6.309
Rle3	6.020	6.129	6.121	6.172	6.123	6.325	6.123	6.172
Rle4	5.707	5.804	5.779	5.842	5.804	6.012	5.804	5.860
Rle5	5.118	5.342	5.359	5.392	5.804	5.560	5.804	5.245
Rle6	4.356	4.356	4.343	3.924	4.343	4.369	4.356	4.356
Rte1	7.290	7.442	----	7.455	----	7.252	7.442	7.442
Rte2	7.290	7.442	----	7.442	----	7.252	7.442	7.442
Rte3	6.350	----	----	6.502	----	7.233	6.515	6.502

(b) Lengths in inches

Line	Suspension-line lengths for test -							
	100T	101T	102T	103T	104T	105T	106T	107T
Lle1	247.9	251.5	256.0	253.8	253.5	259.9	251.5	253.9
Lle2	242.4	246.3	246.75	248.0	246.25	254.4	246.25	248.4
Lle3	237.0	241.3	244.75	242.8	252.5	249.0	241.25	243.0
Lle4	224.7	229.0	229.0	230.5	229.0	236.7	229.0	230.7
Lle5	201.5	210.3	213.5	212.5	212.5	218.9	210.25	206.5
Lle6	171.5	171.5	171.0	154.0	171.0	172.0	171.5	171.5
Lte1	287.0	293.0	-----	294.0	-----	285.0	293.0	293.0
Lte2	287.0	293.0	-----	293.0	-----	286.0	293.0	293.0
Lte3	250.0	256.5	-----	256.0	-----	248.75	256.5	256.0
Lk1	260.2	263.3	266.75	266.2	266.0	272.2	263.25	266.2
Lk2	264.3	265.5	265.25	269.8	265.5	276.3	265.5	270.2
Lk3	262.9	264.3	264.0	268.0	264.25	274.9	264.25	268.9
Lk4	260.2	261.8	261.75	265.0	261.75	272.2	261.75	266.2
Lk5	260.2	262.0	262.0	264.8	262.0	272.2	262.0	266.2
Lk6	260.2	261.8	262.0	264.8	261.75	272.2	261.75	266.2
Lk7	258.5	259.0	261.75	263.3	262.5	269.5	259.0	263.5
Lk8	257.5	259.3	258.75	263.0	259.25	269.5	254.25	263.5
Lk9	256.1	257.5	258.0	262.3	257.5	268.1	257.5	262.1
Lk10	253.3	254.8	254.25	259.5	254.75	265.3	254.75	259.3
Lk11	247.9	249.0	248.75	254.3	249.0	259.9	240.0	253.9
Lk12	248.0	250.0	264.25	260.8	260.75	259.9	250.0	253.9
Rk1	260.2	263.3	264.0	266.0	263.25	272.2	263.25	266.2
Rk2	264.3	265.0	266.0	270.0	265.0	276.5	265.0	270.3
Rk3	262.9	263.5	263.75	268.5	263.5	274.9	263.5	268.9
Rk4	260.2	261.5	261.0	266.5	261.5	272.2	261.5	266.2
Rk5	260.2	261.8	261.5	266.0	261.75	272.2	261.75	266.2
Rk6	260.2	261.5	261.5	266.0	261.5	272.2	261.5	266.2
Rk7	258.5	259.0	259.0	263.5	259.0	269.5	259.0	263.5
Rk8	257.5	259.3	258.5	264.0	259.25	269.5	259.25	263.5
Rk9	256.1	258.0	257.5	262.0	258.0	268.1	258.0	262.1
Rk10	253.3	254.5	254.75	259.5	254.5	265.3	254.5	259.3
Rk11	247.9	248.8	249.25	253.3	248.75	259.9	248.75	253.4
Rk12	248.0	250.0	260.0	261.0	259.25	259.9	250.0	253.9
Rle1	247.9	251.5	255.5	254.5	215.5	259.5	251.5	253.9
Rle2	242.4	246.3	246.5	248.0	246.25	254.4	246.25	248.4
Rle3	237.0	241.3	241.0	243.0	241.25	249.0	241.25	254.0
Rle4	224.7	228.5	227.5	230.0	228.5	236.7	228.5	230.7
Rle5	201.5	210.3	211.0	212.3	210.25	218.9	210.25	206.5
Rle6	171.5	171.5	171.0	154.5	171.0	172.0	171.5	171.5
Rte1	287.0	293.0	-----	293.5	-----	285.5	293.0	293.0
Rte2	287.0	293.0	-----	293.0	-----	285.5	293.0	293.0
Rte3	250.0	256.5	-----	256.0	-----	284.75	256.5	256.0

TABLE III.- INSTRUMENTATION SUMMARY

Test	Test sequence	Parawing	Data figure	Total load link	Suspension-line load link on line -							Reefing line load link on reefing line*			Acceleration along axis
100S	4	1	14	1	k3	k5	k10	Lte1	Lle1	Lle3	Lle6	1r	2r	3r	-----
101S	5	2	15	1	k1	k7	k12	Lte3	Lle2	Lle4	Lle6	---	---	---	X, Y, Z
102S	1	3	16	1	k1	k7	k12	Lte3	Lle2	Lle4	Lle6	---	---	---	X, Y, Z
103S	2	1	17	1	k3	k5	k10	Lte1	Lle1	Lle3	Lle6	1r	2r	---	Z
104S	3	2	18	1	k1	k7	k12	Lte3	Lle2	Lle4	Lle6	---	---	---	X, Y, Z
105S	6	1	19	1	k3	k5	k10	Lte1	Lle1	Lle3	Lle6	1r	2r	**2r	-----
106S	7	2	20	1	k1	k7	k12	Lte3	Lle2	Lle4	Lle6	---	---	---	X, Y, Z
107S	8	3	21	1			k12		Lle2	Lle4	Lle6	---	---	---	X, Y, Z
100T	4	1	22	1	Lk3	Lk6	Lk9	Lte2	Lle2	Lle4	Lle6	Rr	Lr	Cr	-----
101T	5	2	23	1	Lk1	Lk12	Lte1	Lle1	Lle3	Lle5	Lle6	---	---	---	X, Y, Z
102T	1	3	24	1	Lk1	Lk7	Lk12	Lle1	Lle3	Lle5	Lle6	---	---	---	X, Y, Z
103T	2	1	25	1	Lk3	Lk6	Lk9	Lte2	Lle2	Lle4	Lle6	Rr	Lr	Cr	-----
104T	3	2	26	1	Lk1	Lk7	Lk12	Lle1	Lle3	Lle5	Lle6	---	---	---	X, Y, Z
105T	6	1	27	1	Lk3	Lk6	Lk9	Lte2	Lle2	Lle4	Lle6	ter	Lr	Cr	-----
106T	7	2	28	1	Lk1	Lk12	Lte1	Lle1	Lle5	Lle6	----	---	---	---	X, Y, Z
107T	8	3	29	1	Lk1	Lk12	Lte1	Lle1	Lle5	Lle6	----	---	---	---	X, Y, Z

*See figures 9 and 10 for location of reefing line.

** Second-stage reefing line on right and left lobe instrumented.

TABLE IV.- TEST CONDITIONS, EVENT TIMES, AND COMMENTS FOR SINGLE-KEEL PARAWING TESTS

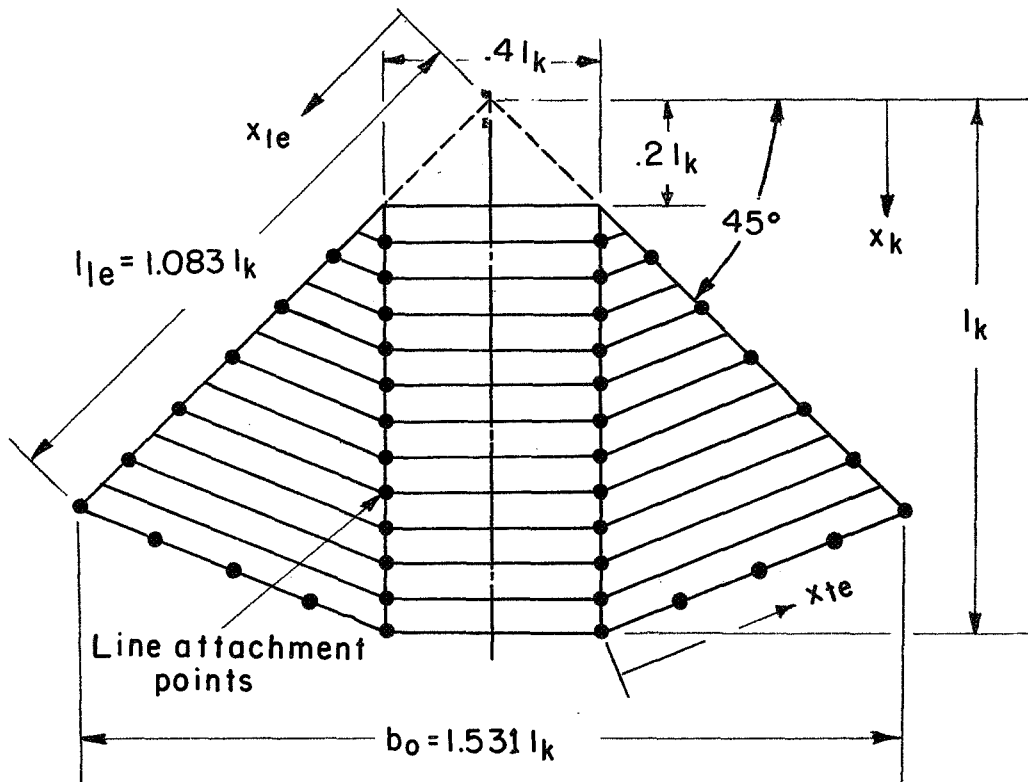
Test	Test sequence	Data figure	Programmer parachute disconnect conditions				Suspended weight		Descent weight		Reefing version	t_r/t_k	Event times, seconds after launch						Comments*
			q, N/m ²	q, lb/ft ²	h, m	h, ft	W _P , N	W _P , lb	W _D , N	W _D , lb			t _{PD}	t _{LS}	t _{1DR}	t _{2DR}	t _{3DR}	t _{LT}	
100S	5	14	1723.7	36.0	4082	13 394	793.4	178.4	937.9	210.8	III	0.120	26.87	27.75	30.25	32.96	36.48	39.27	Second-stage inflated shape was unsymmetrical and system went into spin during second stage. First-stage total load data invalid because of peak induced by oscillating instrumentation package.
101S	4	15	1757.2	36.7	4075	13 370	797.2	179.2	934.1	210.0	III	.116	26.27	27.13	29.69	32.57	36.26	38.94	All stages functioned properly.
102S	2	16	1584.8	33.1	1004	3 294	1007.5	226.5	1141.1	257.2	II	.156	27.39	38.09	30.66	33.96	37.18	39.45	Rear keel line momentarily hung up at line transfer. Reefing system function was satisfactory.
103S	3	17	2183.3	45.6	931	3 055	971.4	218.5	1112.1	250	II	.141	24.13	24.92	27.47	30.34	34.29	36.71	Suspension line L1e1 did not release at line transfer because of cutter malfunction. Reefing stages prior to line transfer functioned properly.
104S	1	18	2355.7	49.2	986	3 236	983.1	221	1124.5	252.8	I	.201	10.22	11.10	----	16.45	20.39	22.85	Second stage did not occur because of reefing line lockup. Validity of ASKANIA data doubtful.
105S	7	19	2063.6	43.1	1024	3 361	991.1	222.8	1138.3	255.9	II	.120	24.08	24.86	26.98	29.93	34.39	36.67	Apparently good flight.
106S	6	20	3786.2	78.7	5778	18 956	2088.4	469.5	2225.4	500.3	II	.116	29.57	29.96	35.33	40.06	41.39	44.85	First-stage inflation O.K. Bomb went into flat spin during first stage after inflation. Spin damped out at second-stage opening. Lines twisted because of spin. Line load data after stage 1 not valid because of twisted line.
107S	8	21	4122.5	86.1	5965	19 570	2059.1	462.9	2197.0	493.9	II	.116	26.93	27.44	32.71	36.18	38.80	42.42	Deployment sequence was normal.

*These comments taken from reference 7.

TABLE V.- TEST CONDITIONS, EVENT TIMES, AND COMMENTS FOR TWIN-KEEL PARAWING TESTS

Test	Test sequence	Data figure	Programmer parachute disconnect conditions				Suspended weight		Descent weight		Reefing version	t_r/t_k	Event times, seconds after launch						Comments*
			q, N/m ²	q, lb/ft ²	h, m	h, ft	W _P , N	W _P , lb	W _D , N	W _D , lb			t _{PD}	t _{LS}	t _{1DR}	t _{2DR}	t _{3DR}	t _{LT}	
100T	5	22	1695.0	35.4	3362	11 030	795.6	178.9	962.3	216.3	I	0.167	26.42	27.26	29.64	32.61	36.17	39.13	All stages occurred as planned. Oscillation of instrumentation mass induced high peaks in first-stage total load.
101T	4	23	1747.6	36.5	4037	13 245	798.7	179.6	953.7	214.4	I	.156	25.97	26.86	29.61	32.34	36.79	38.97	All stages functioned properly.
102T	1	24	7181.1	37.2	1222	4 010	975.5	219.3	1130.7	254.2	II	.219	27.30	28.03	31.31	33.30	37.38	36.36	Stages 1, 2, and 3 functioned properly. Stage 4 and stage 5 occurred so close together that it was not possible to evaluate functioning of stage 4.
103T	3	25	2183.3	45.6	997	3 272	976.6	219.6	1129.9	254	I	.167	24.07	24.86	27.09	30.51	33.70	42.49	All stages functioned properly.
104T	2	26	2700.4	56.4	864	2 835	967	217.4	1130.7	254.2	II	.219	23.93	24.70	26.17	30.17	36.65	33.72	Stages 1, 2, and 3 functioned properly. Stage 4 inflation was unstable. Suspension line L1e1 did not release at line transfer because of tight retention loop.
105T	7	27	2164.2	45.2	1095	3 591	973.3	218.8	1137.9	255.8	I	.141	23.83	24.59	26.62	30.33	33.55	36.28	All stages occurred as planned.
106T	6	28	3552.7	74.2	5712	18 740	2079.5	467.5	2234.8	502.4	I	.153	29.49	29.96	35.33	39.64	40.87	48.61	All stages occurred as planned.
107T	8	29	4457.7	93.1	6136	20 130	2063.5	463.9	2218.3	498.7	I	.153	26.76	27.25	32.72	36.92	40.79	42.16	Line transfer on one side failed to occur because of broken wires on release mechanism.

*These comments taken from reference 7.



Suspension-line attachment locations

Keel	Leading edge	Trailing edge
x_k/l_k	x_{le}/l_k	x_{te}/l_k
0.267	0.416	0.153
.333	.549	.306
.400	.683	.459
.467	.816	
.533	.949	
.600	1.083	
.667		
.733		
.800		
.867		
.933		
1.000		

Figure 2.- Flat-pattern details of the 6.919-m (22.7-ft) keel length twin-keel parawing model.

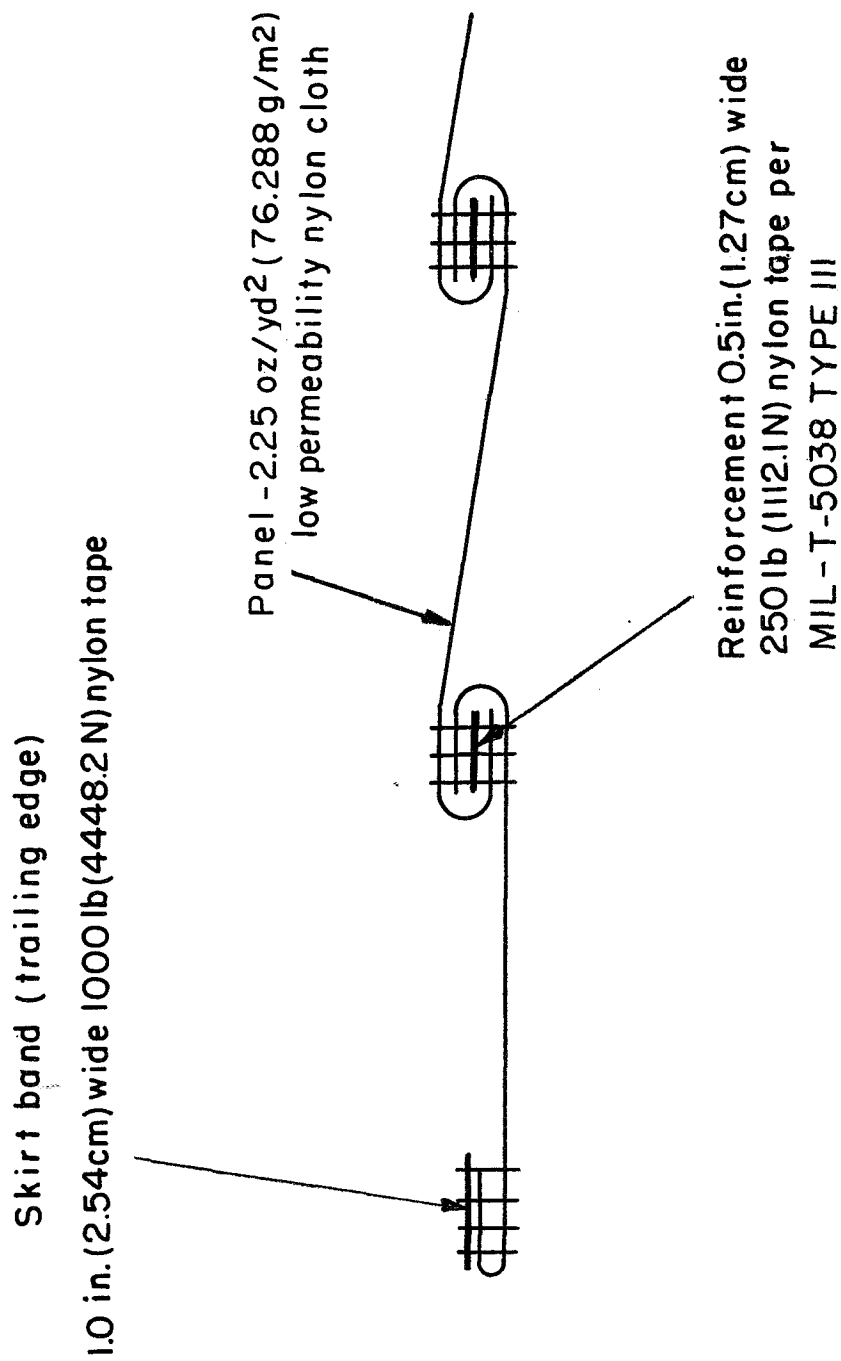
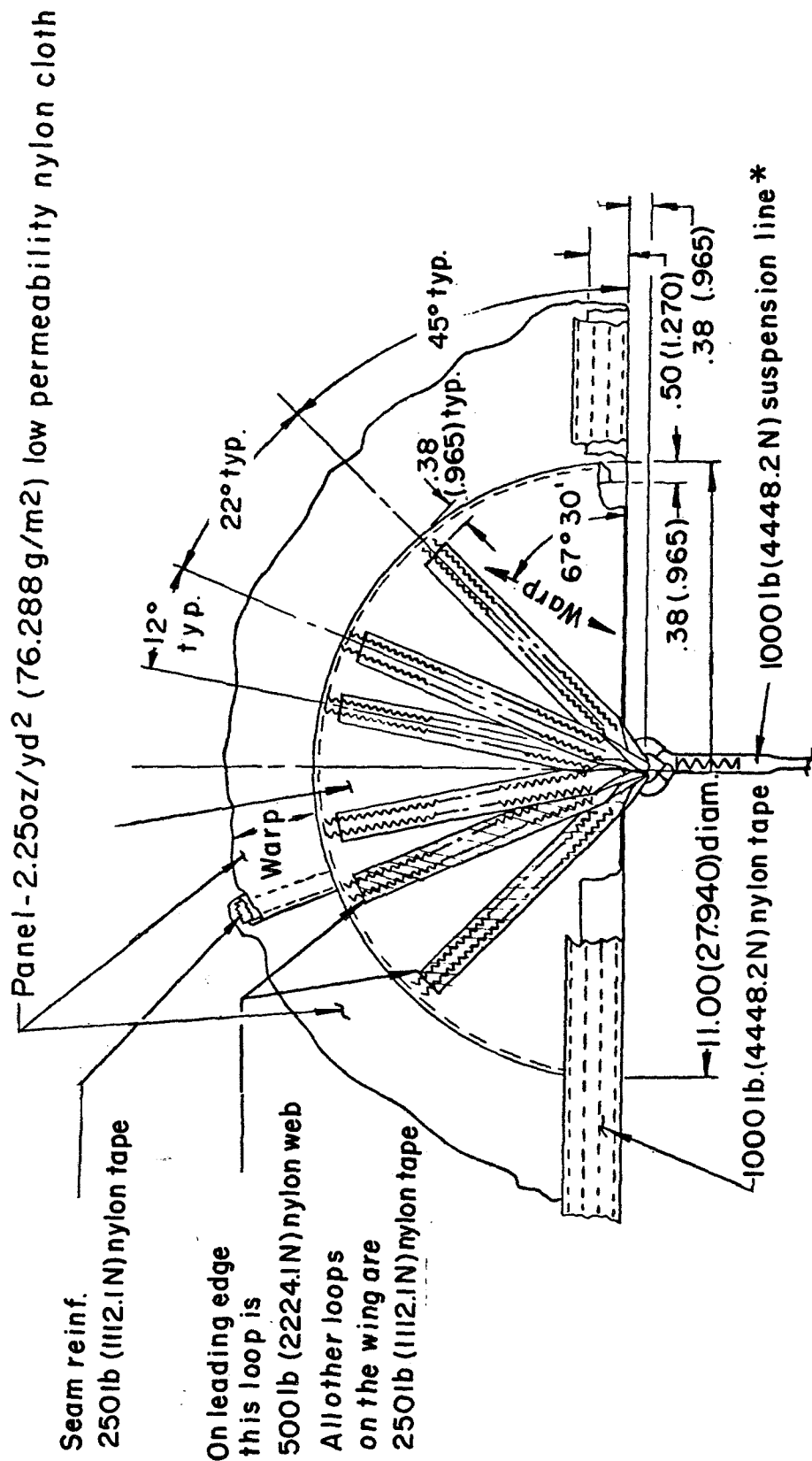
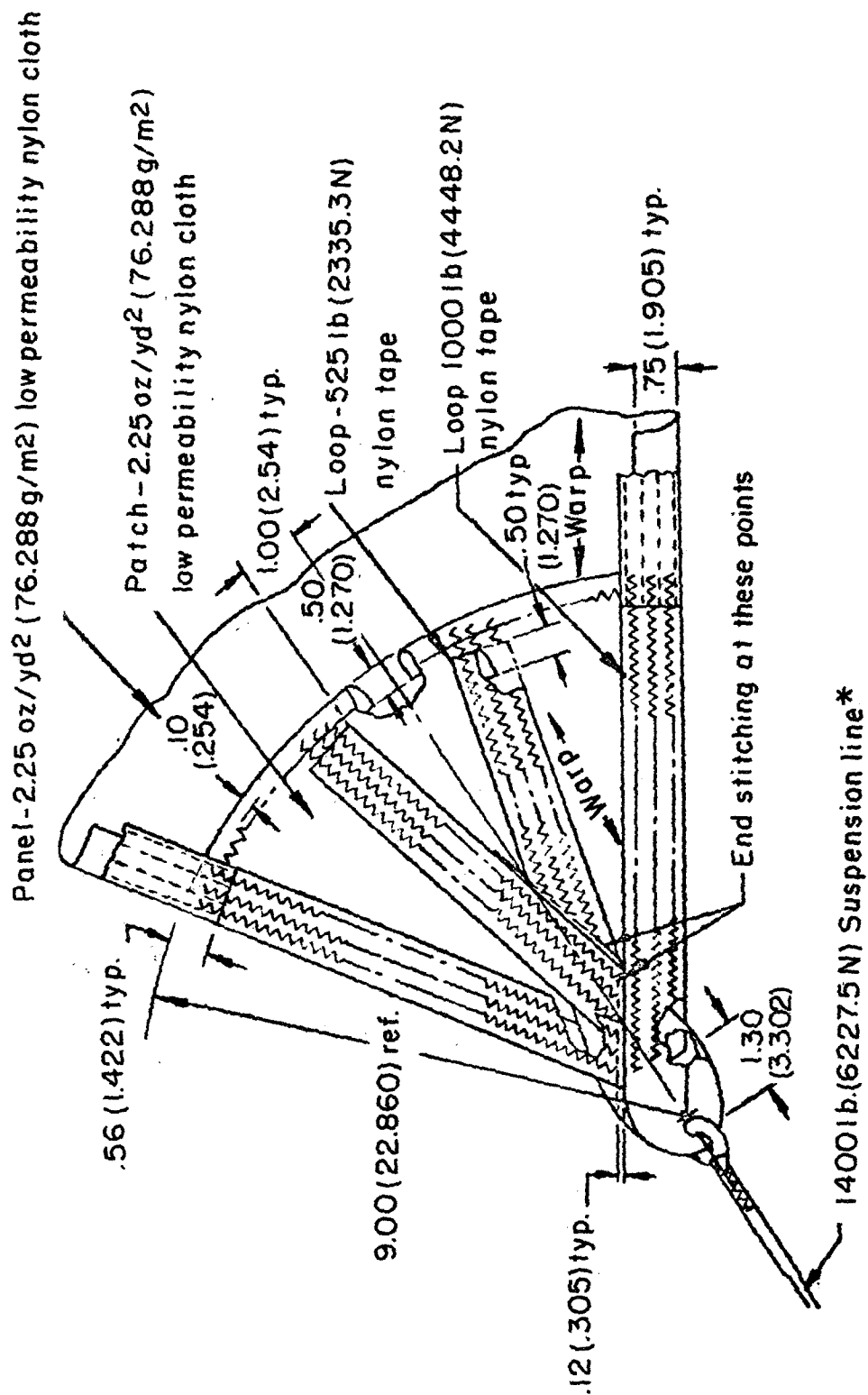


Figure 3.- Detail of canopy seam construction.



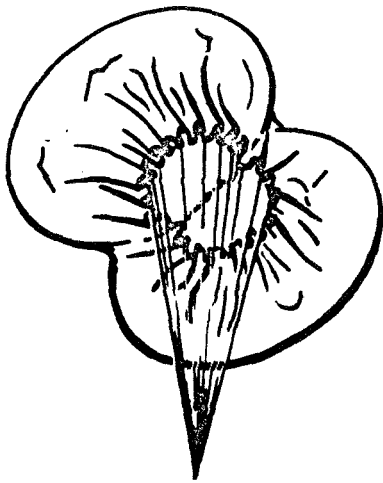
* Nylon suspension lines for tests 102S, 107S, 102T, 107T; all other tests used dacron suspension lines.

Figure 4.- Detail of suspension-line attachment - leading edge, trailing edge, and keel. (Linear dimensions are in inches with centimeters given in parentheses.)

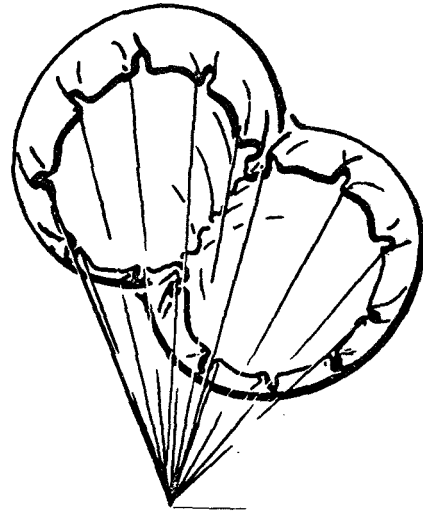


*Nylon suspension lines used for tests 102S, 107S, 102T, 107T; all other tests used dacron suspension lines.

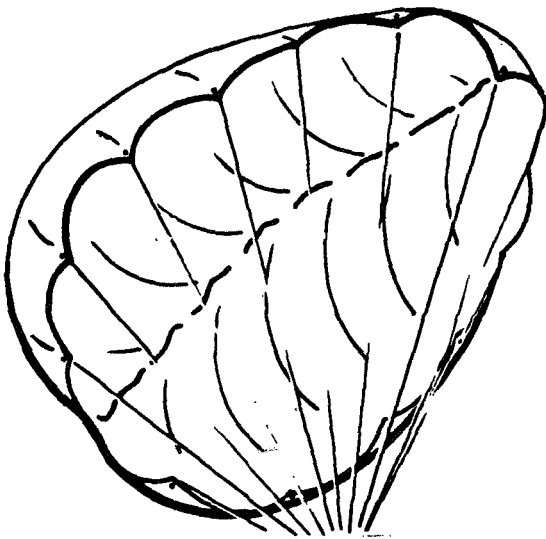
Figure 5.- Details of suspension-line attachment - tip. (Linear dimensions are given in inches with centimeters given in parentheses.)



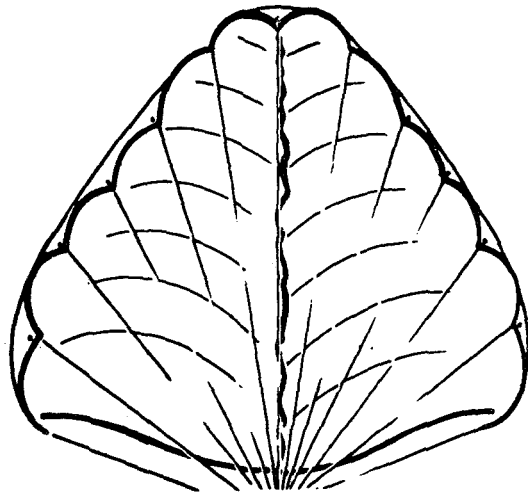
Stage 1



Stage 2



Stage 3



Stage 4 and line transfer

Figure 6.- Planform of single-keel parawing during deployment stages.

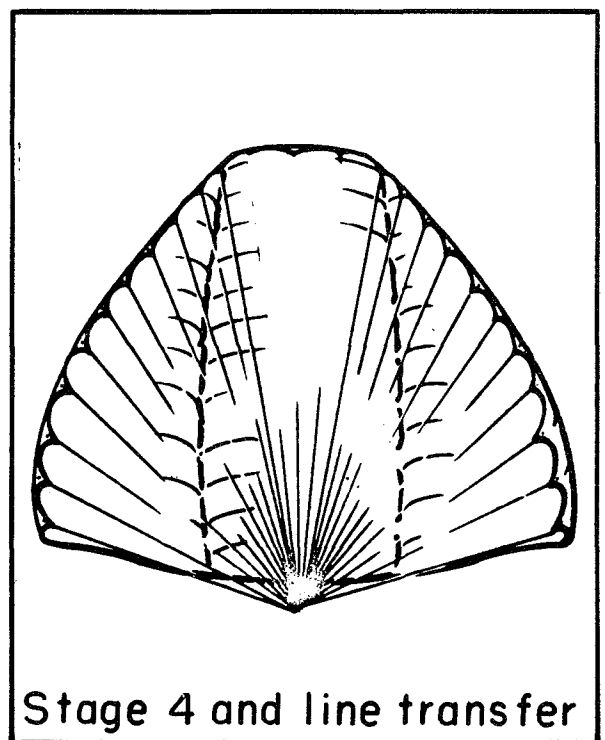
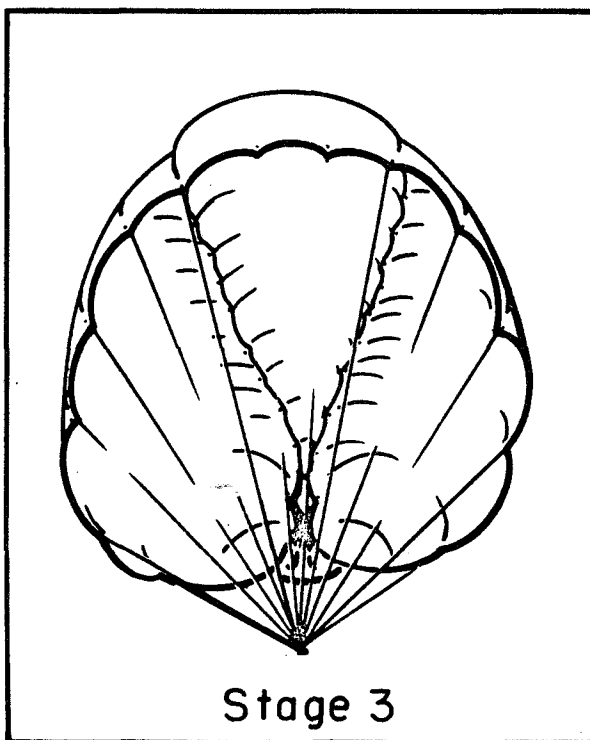
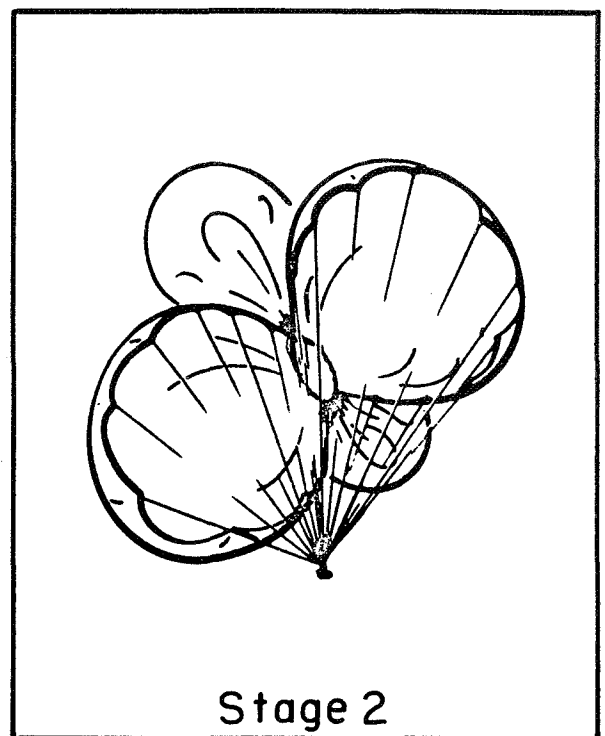
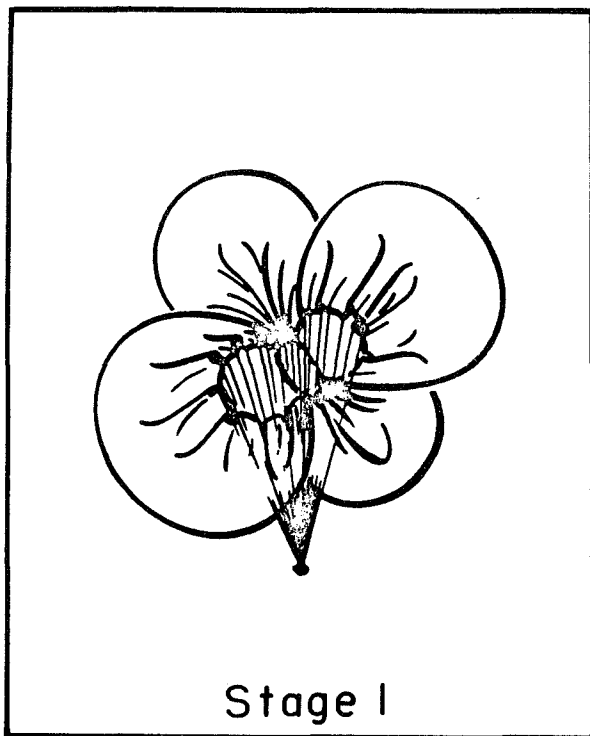


Figure 7.- Planform of twin-keel parawing during deployment stages

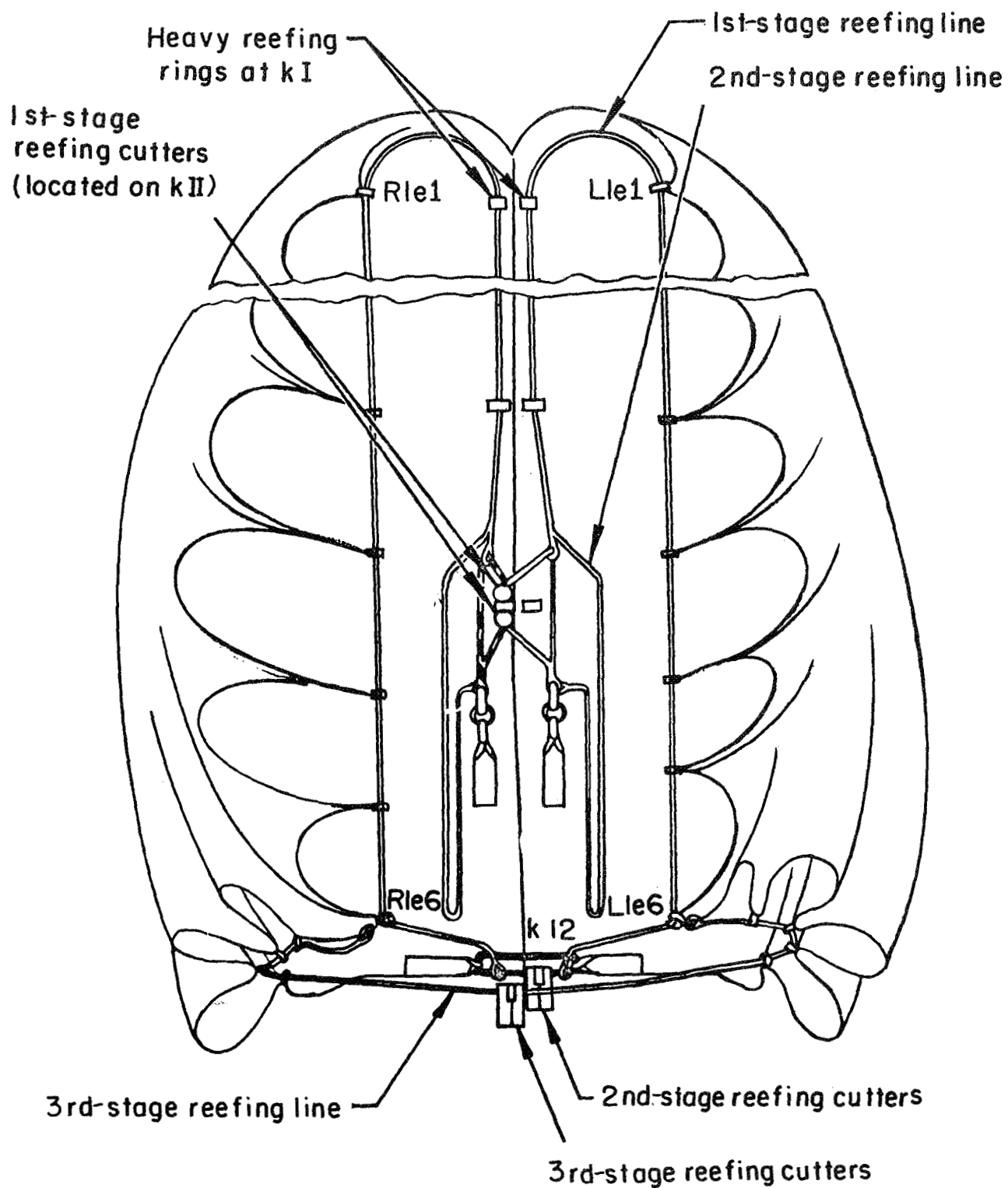


Figure 8.- Schematic of single-keel parawing reefing-line arrangement of reefing version 1.

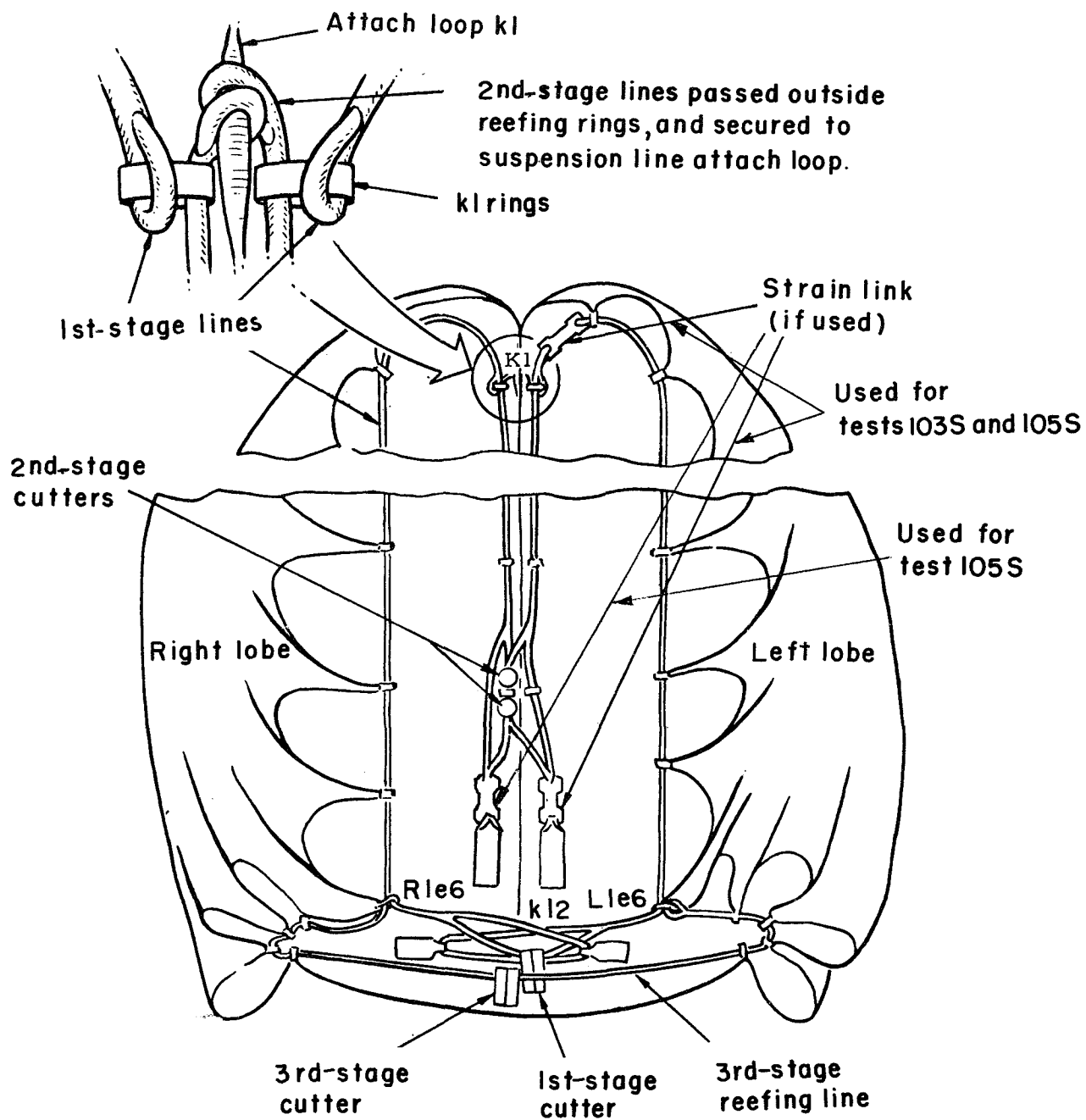


Figure 9.- Schematic of single-keel parawing reefing-line arrangement for reefing version II.

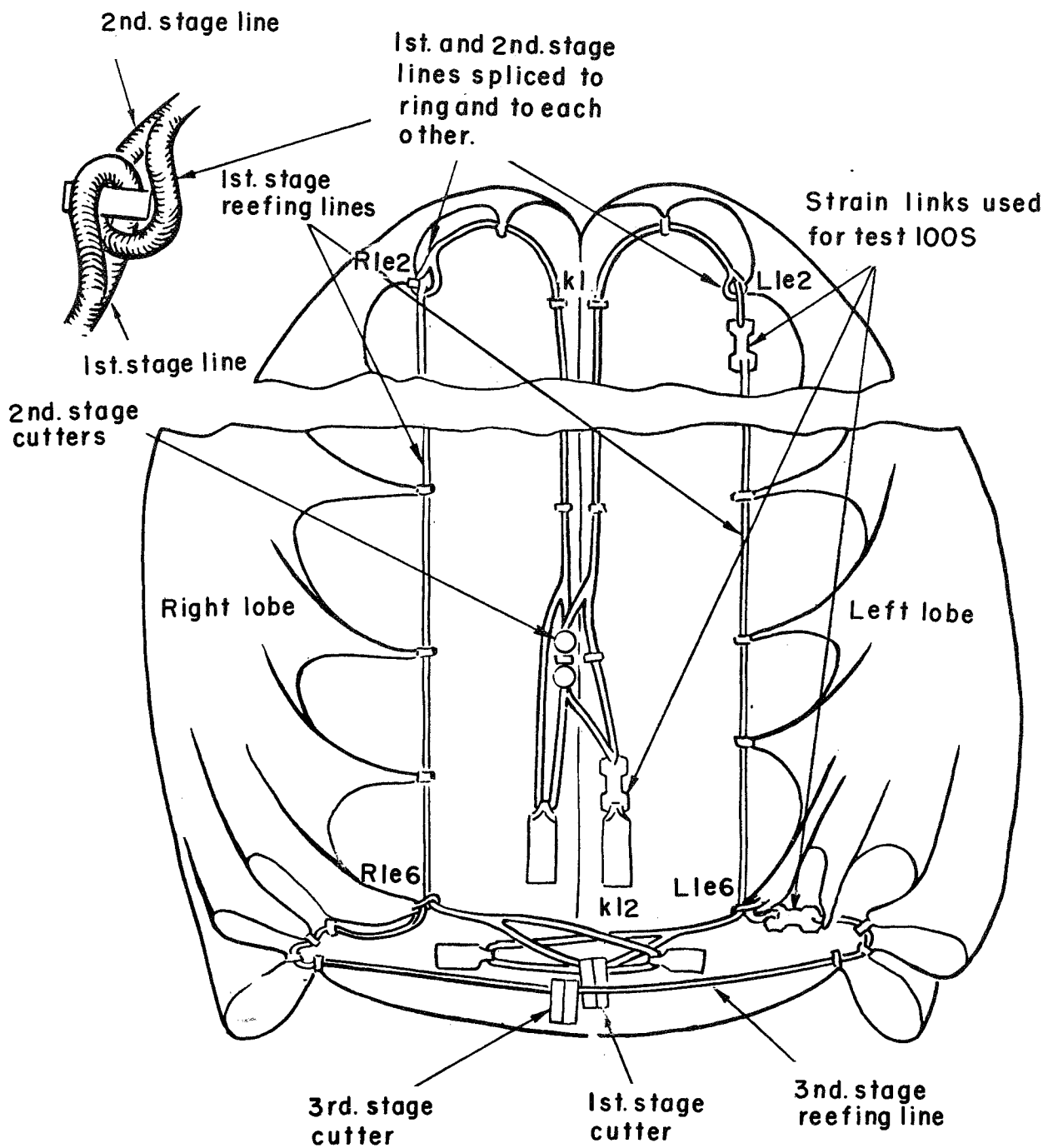


Figure 10.- Schematic of single-keel parawing reefing-line arrangement for reefing version 111.

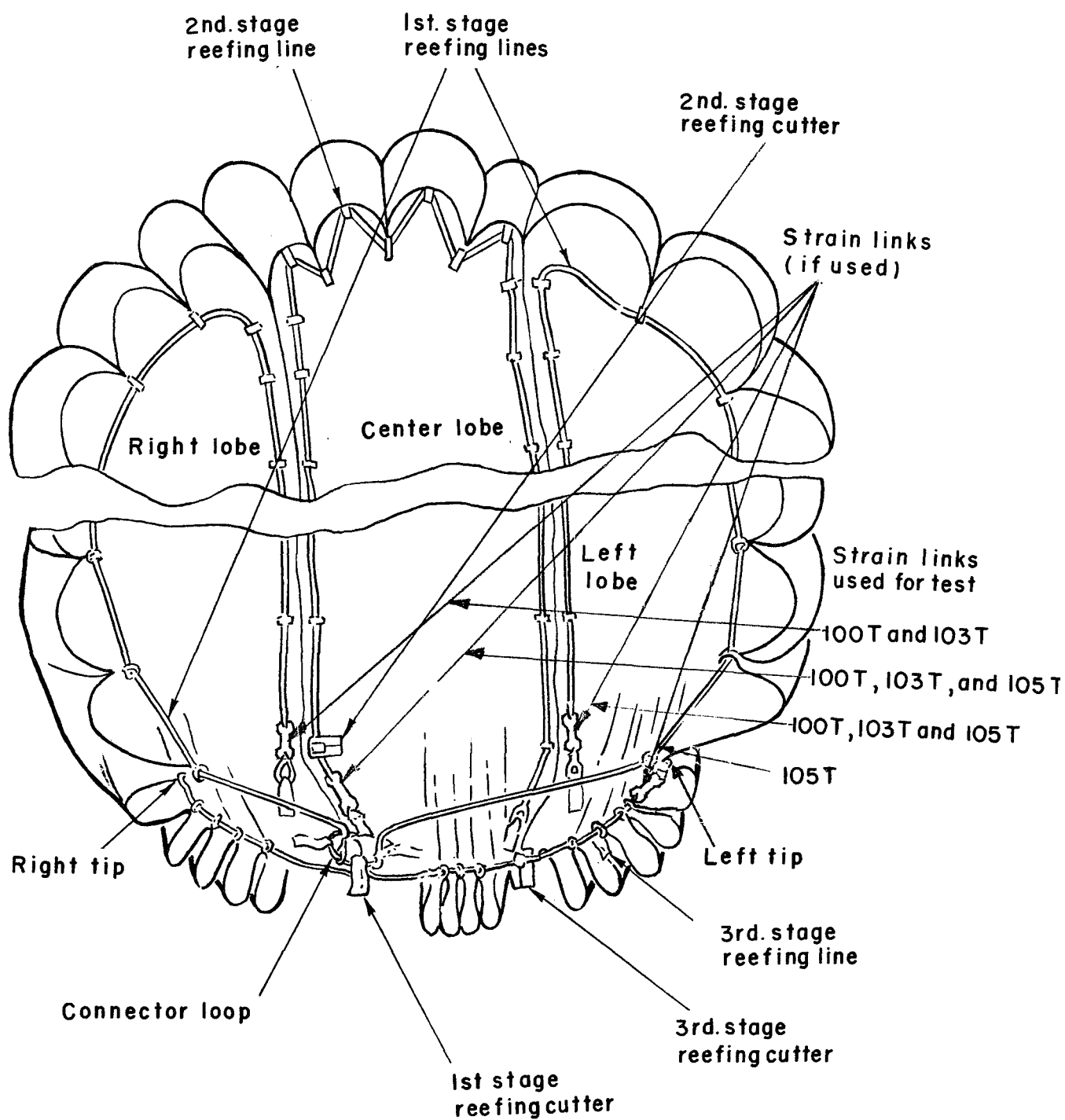


Figure 11.- Schematic of twin-keel parawing reefing-line arrangement for reefing versions I and II.

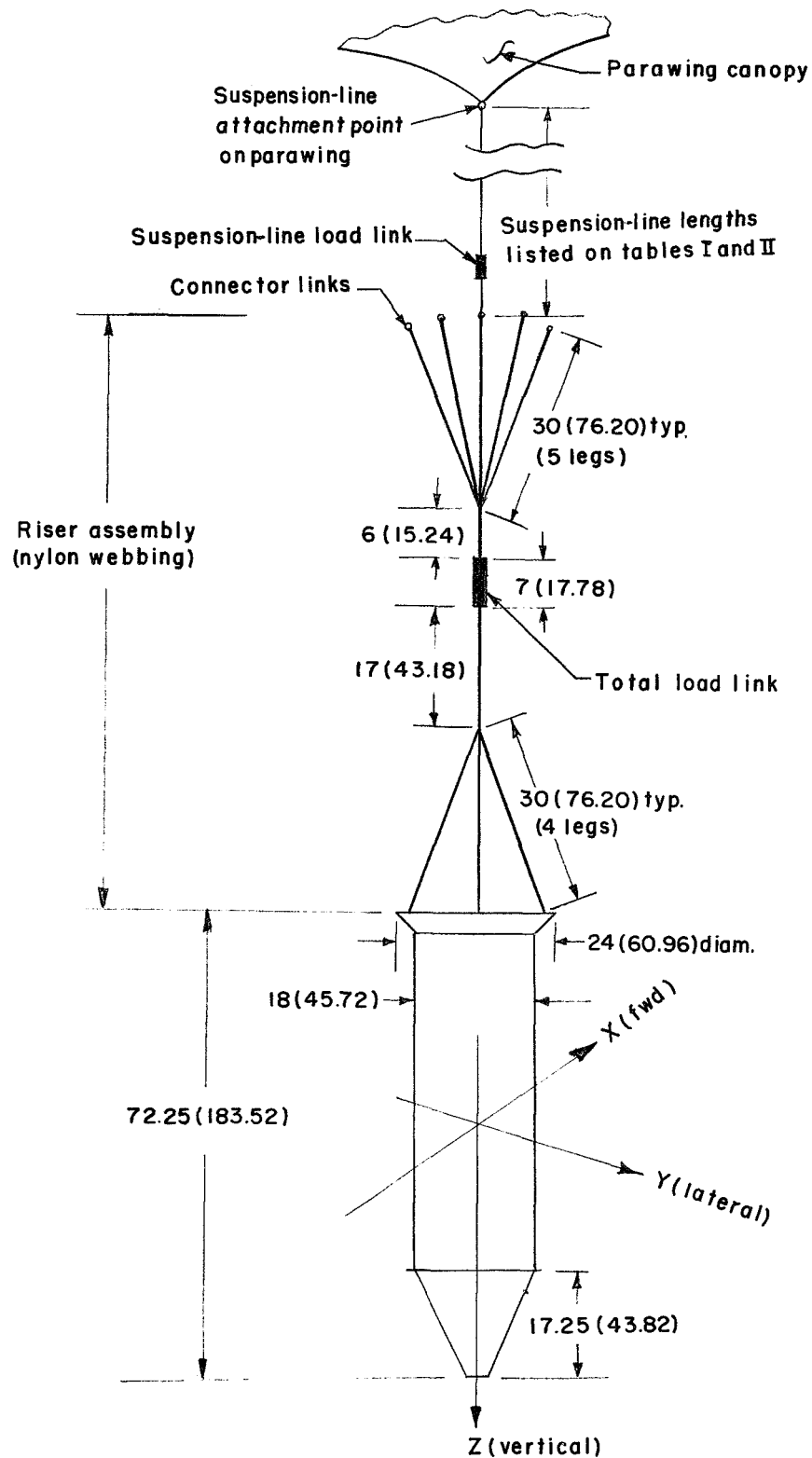


Figure 12.- Schematic showing suspension-line and riser assembly, external envelope of the bomb-type test vehicle, and the axis system used for a_x , a_y , and a_z data. Dimensions are given in inches with centimeters noted in parentheses.

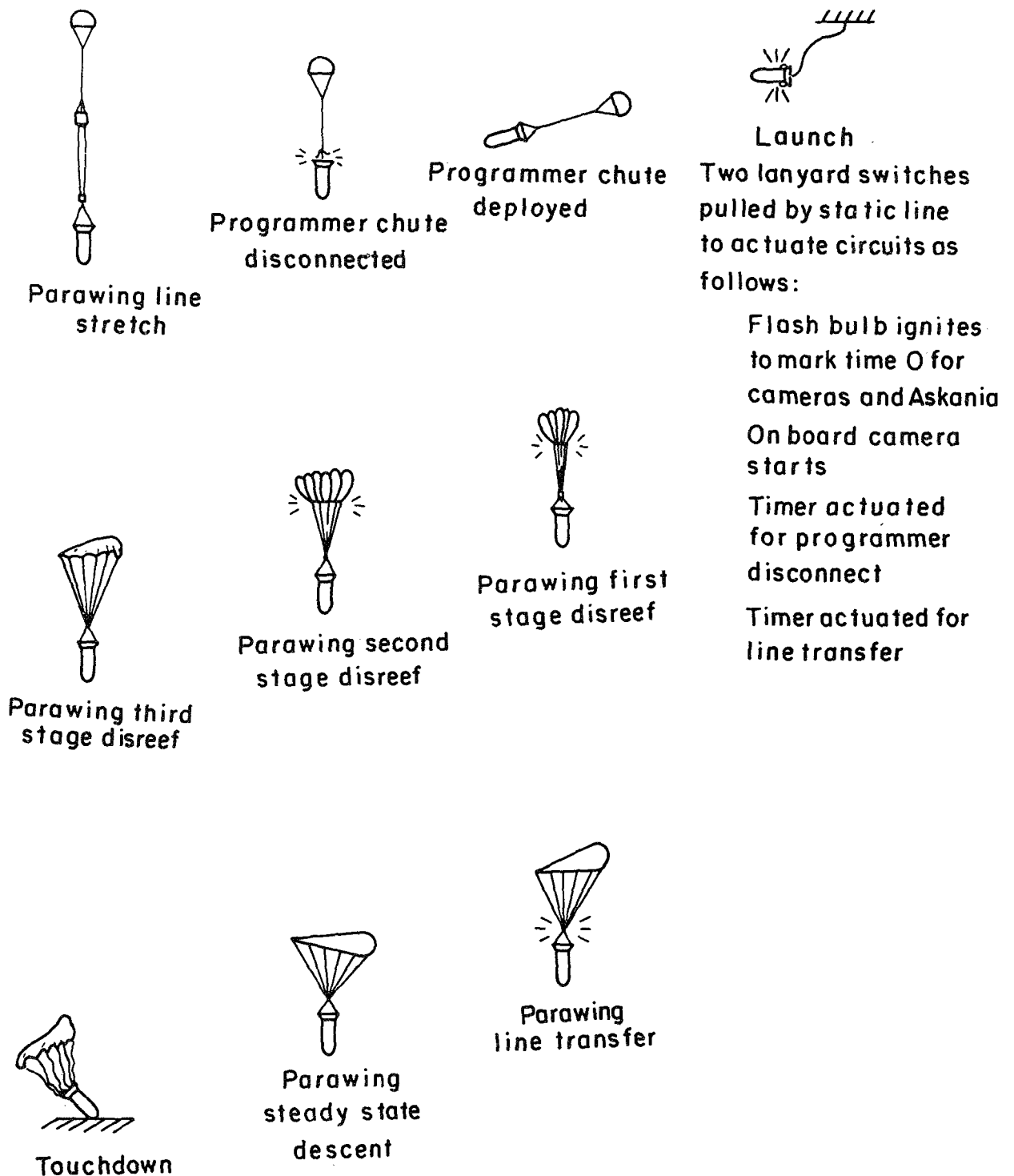
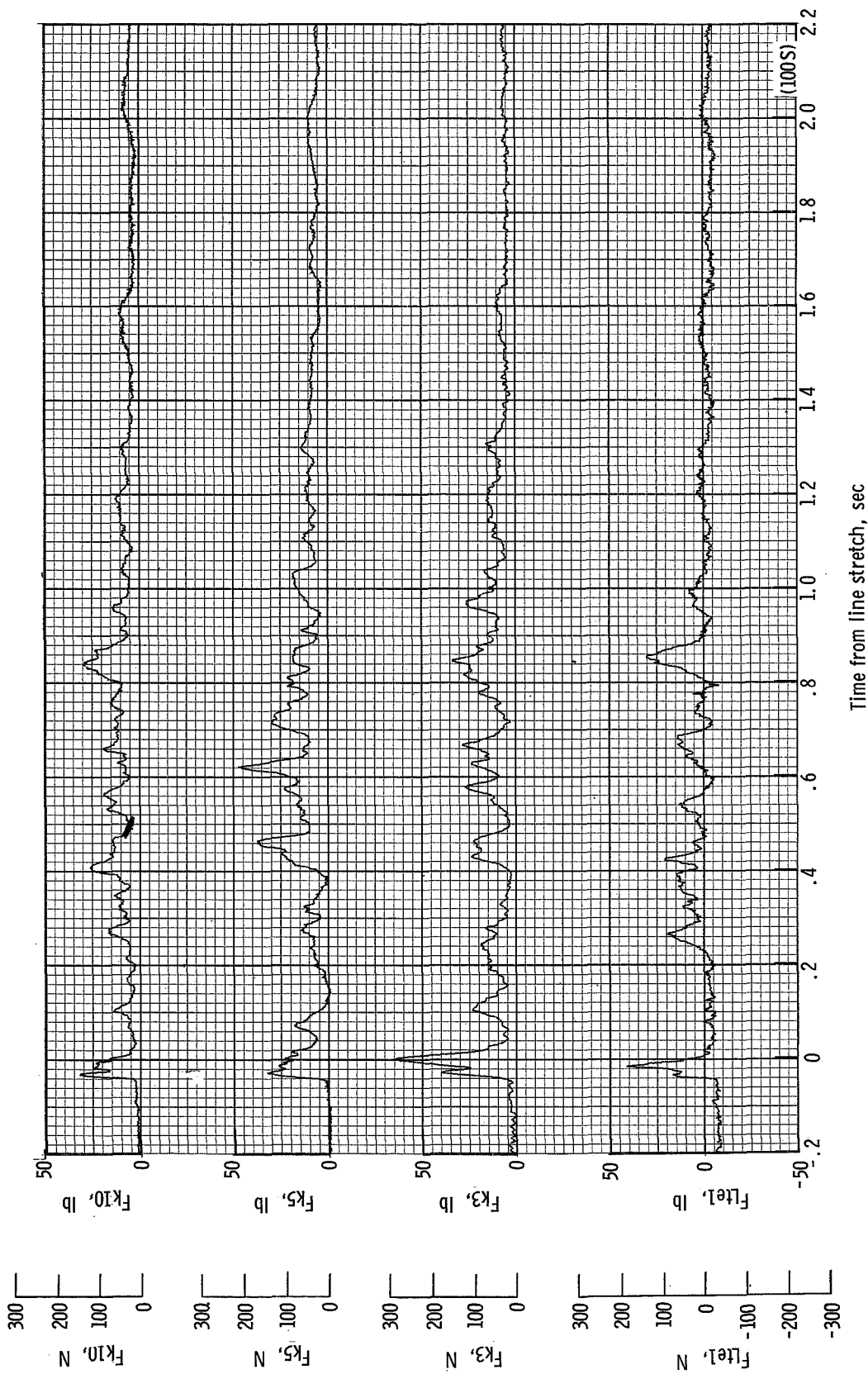
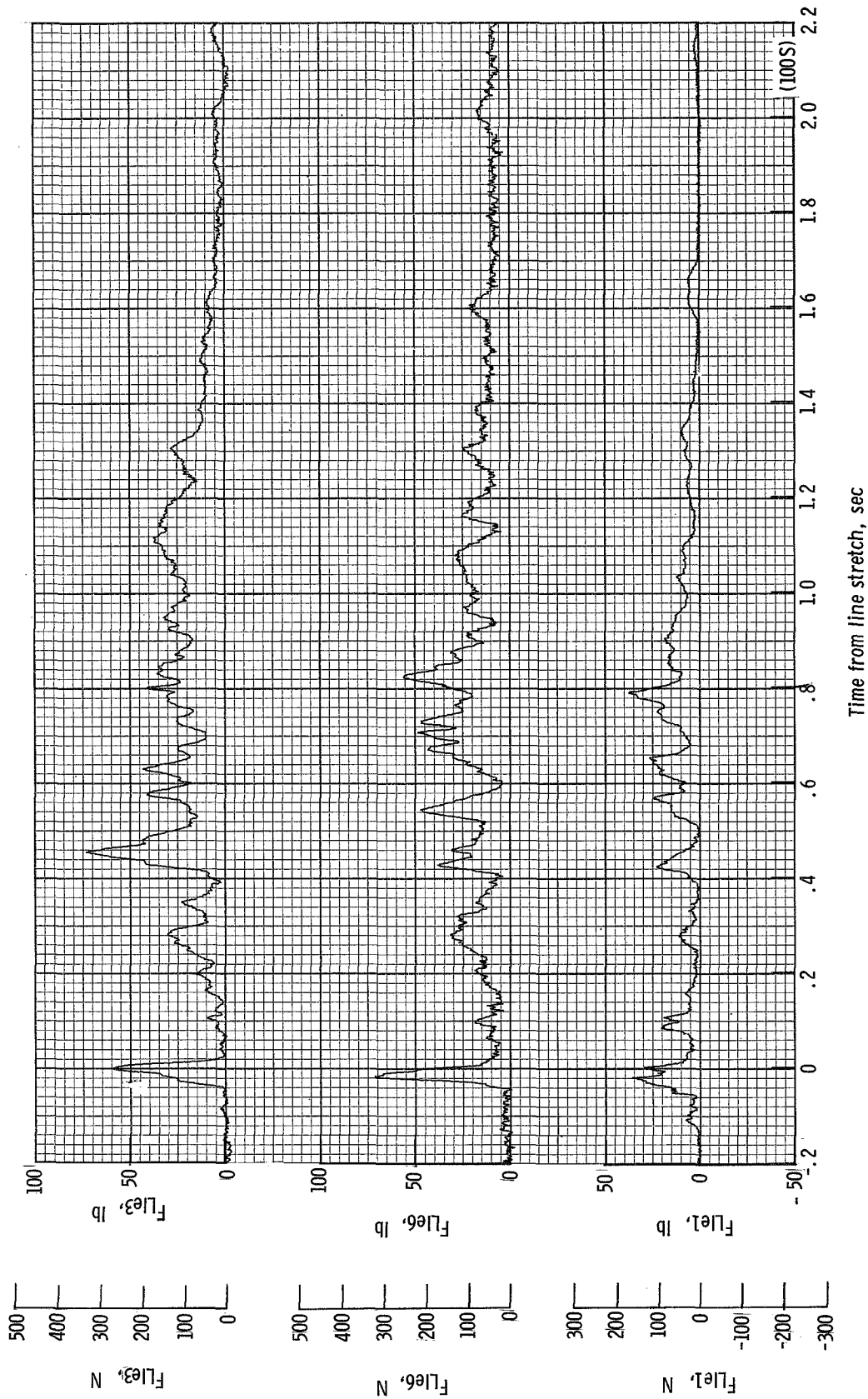


Figure 13.- Sequence of parawing test events.



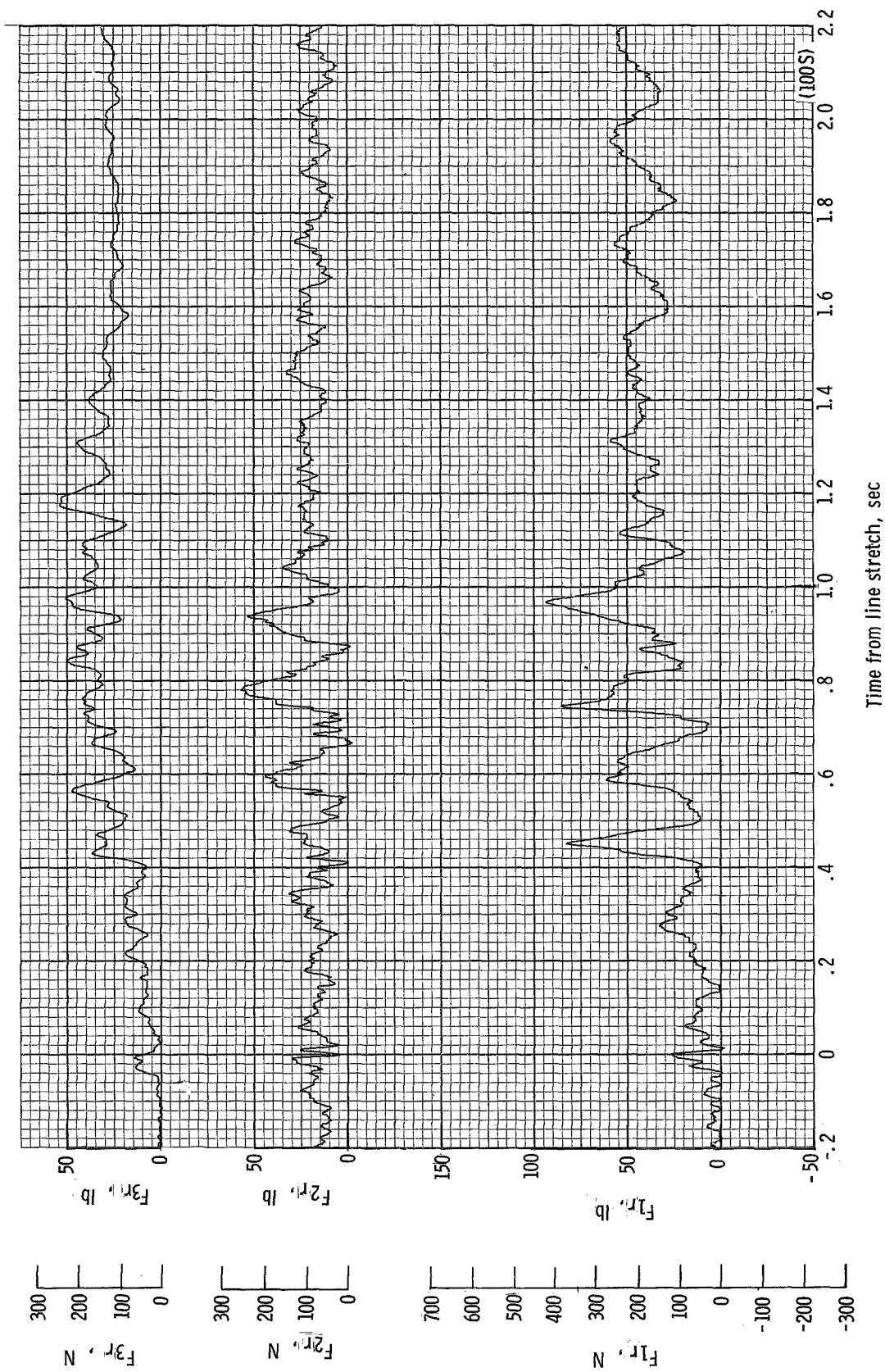
(a) Individual suspension-line loads F_{tel1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from line stretch. Time = 0 second corresponds to 27.75 seconds after launch.

Figure 14.- Time history of single-keel parawing deployment data for test 100S. $W_P = 937.9$ N (210.8 lb); $W_D = 793.4$ N (178.4 lb); $q_{PD} = 1723.7$ N/m² (36.0 lb/ft²); $h_{PD} = 4082$ m (13 394 ft); $t_r/t_k = 0.120$; reefing version III.



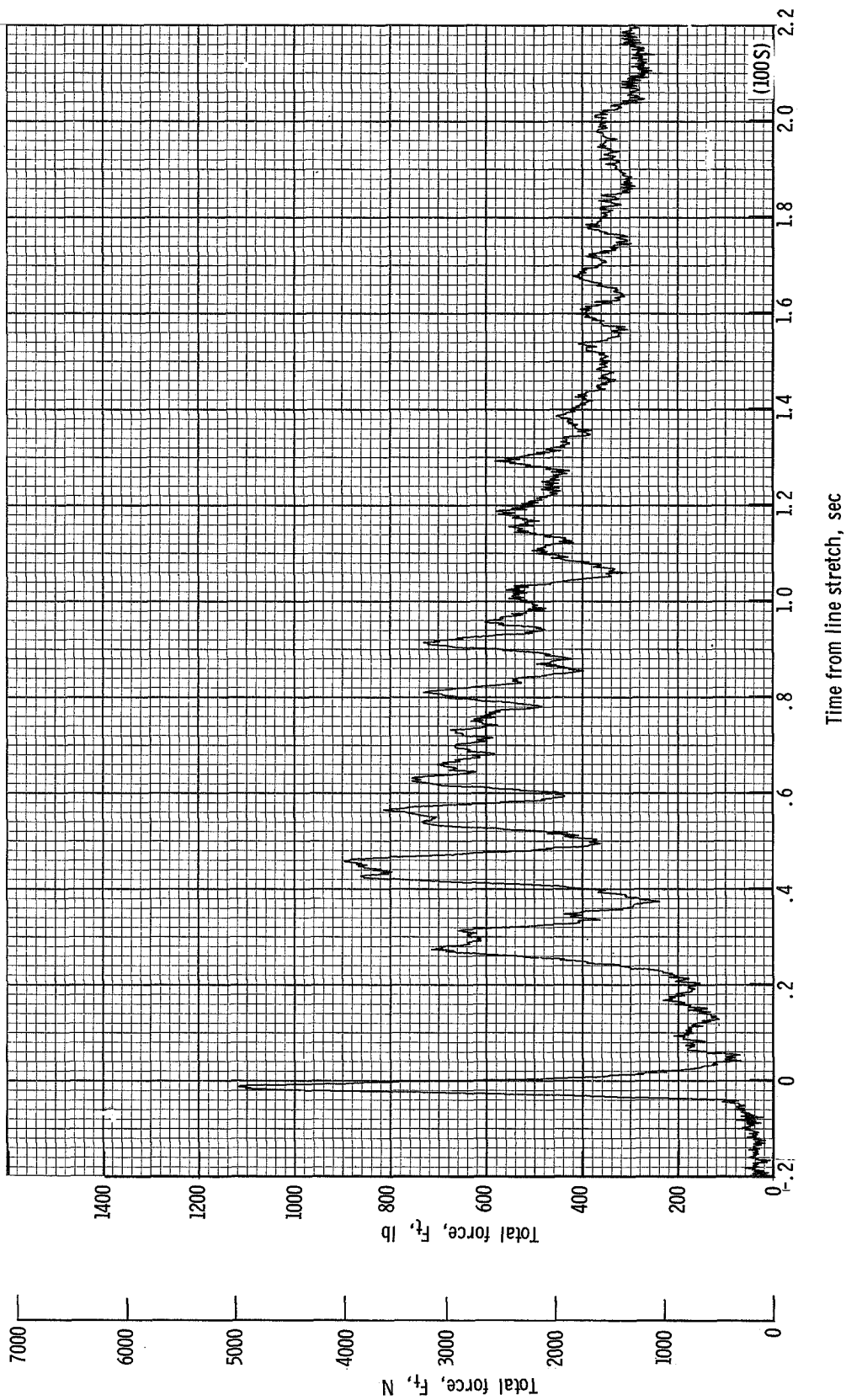
(b) Individual suspension-line loads F_{Lie1} , F_{Lie6} , F_{Lie3} plotted against time from line stretch. Time = 0 second corresponds to 27.75 seconds after launch.

Figure 14.- Continued.



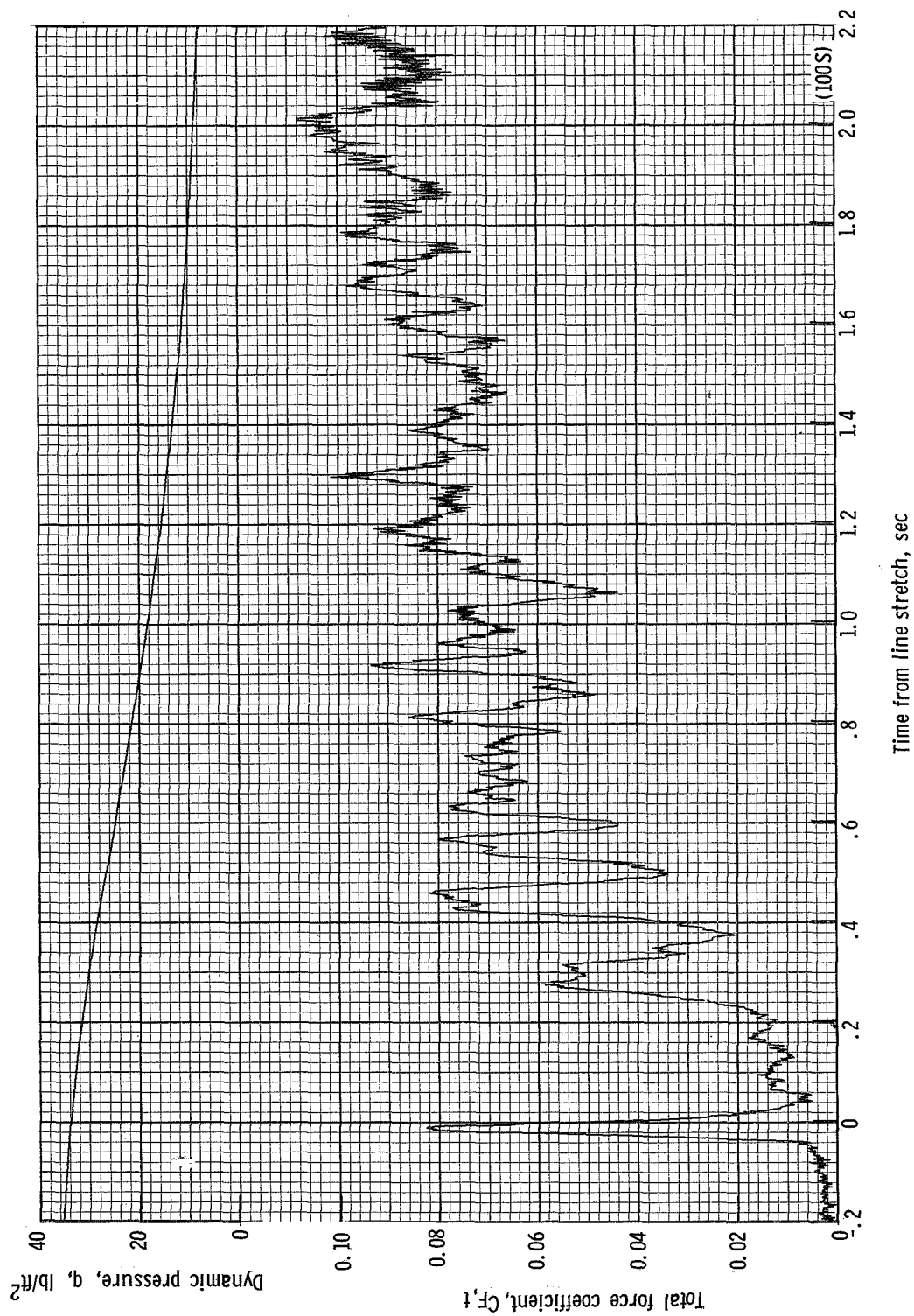
(c) Individual reefing-line loads F_{1r} , F_{2r} and F_{3r} plotted against time from line stretch. Time = 0 second corresponds to 27.75 seconds after launch.

Figure 14:- Continued.



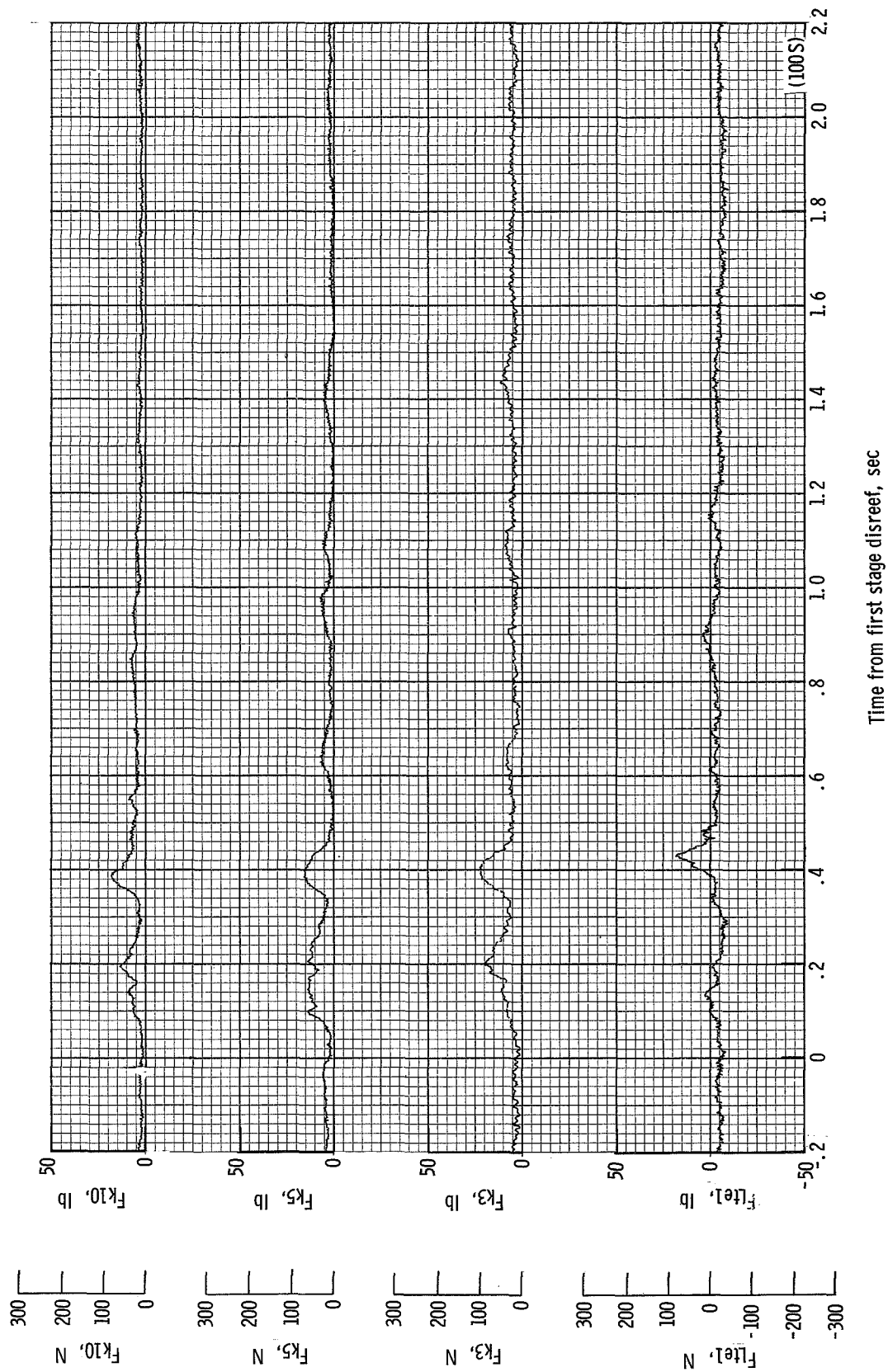
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 27.75 seconds after launch.

Figure 14.- Continued.



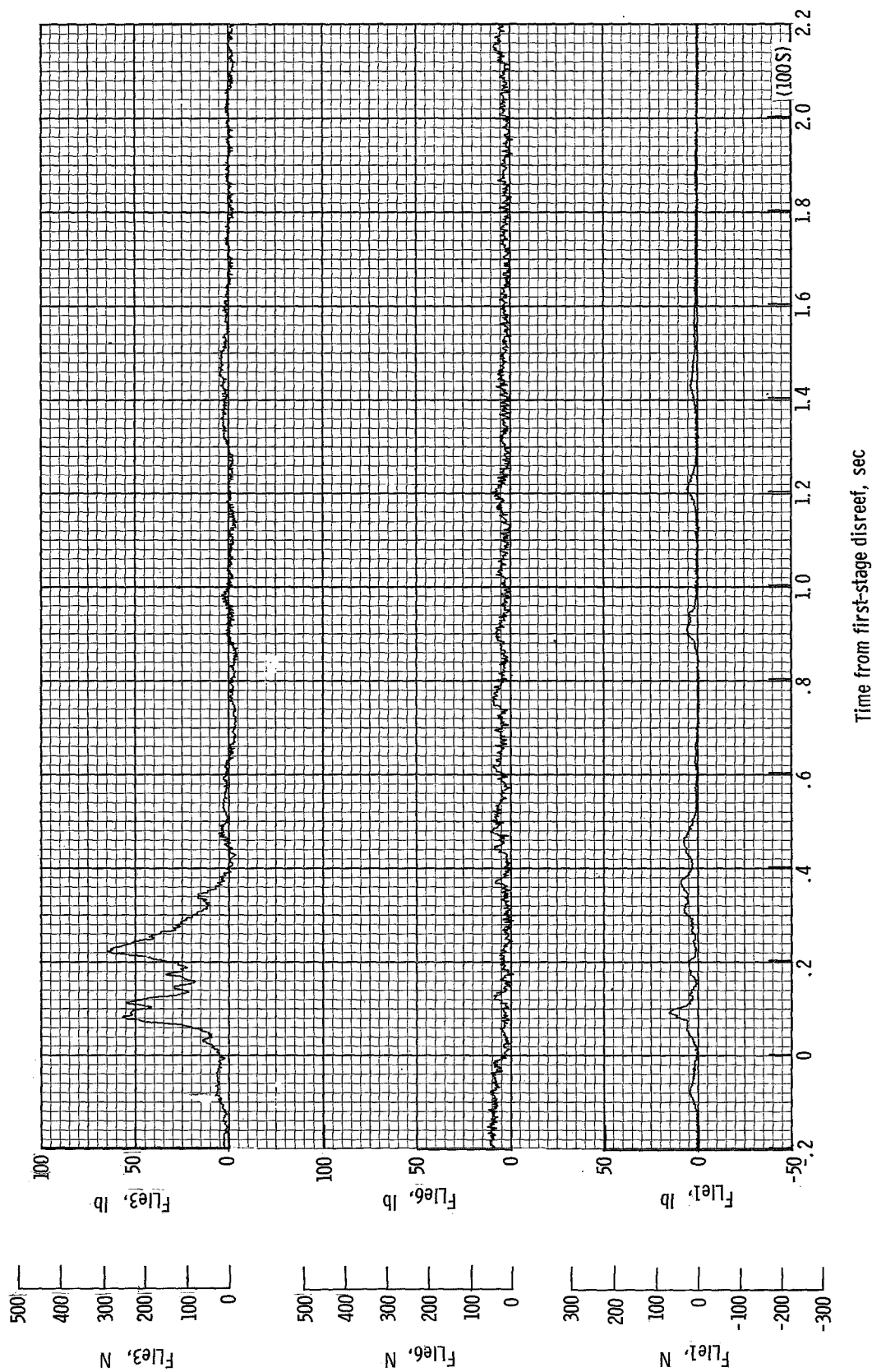
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 27.75 seconds after launch.

Figure 14.- Continued.



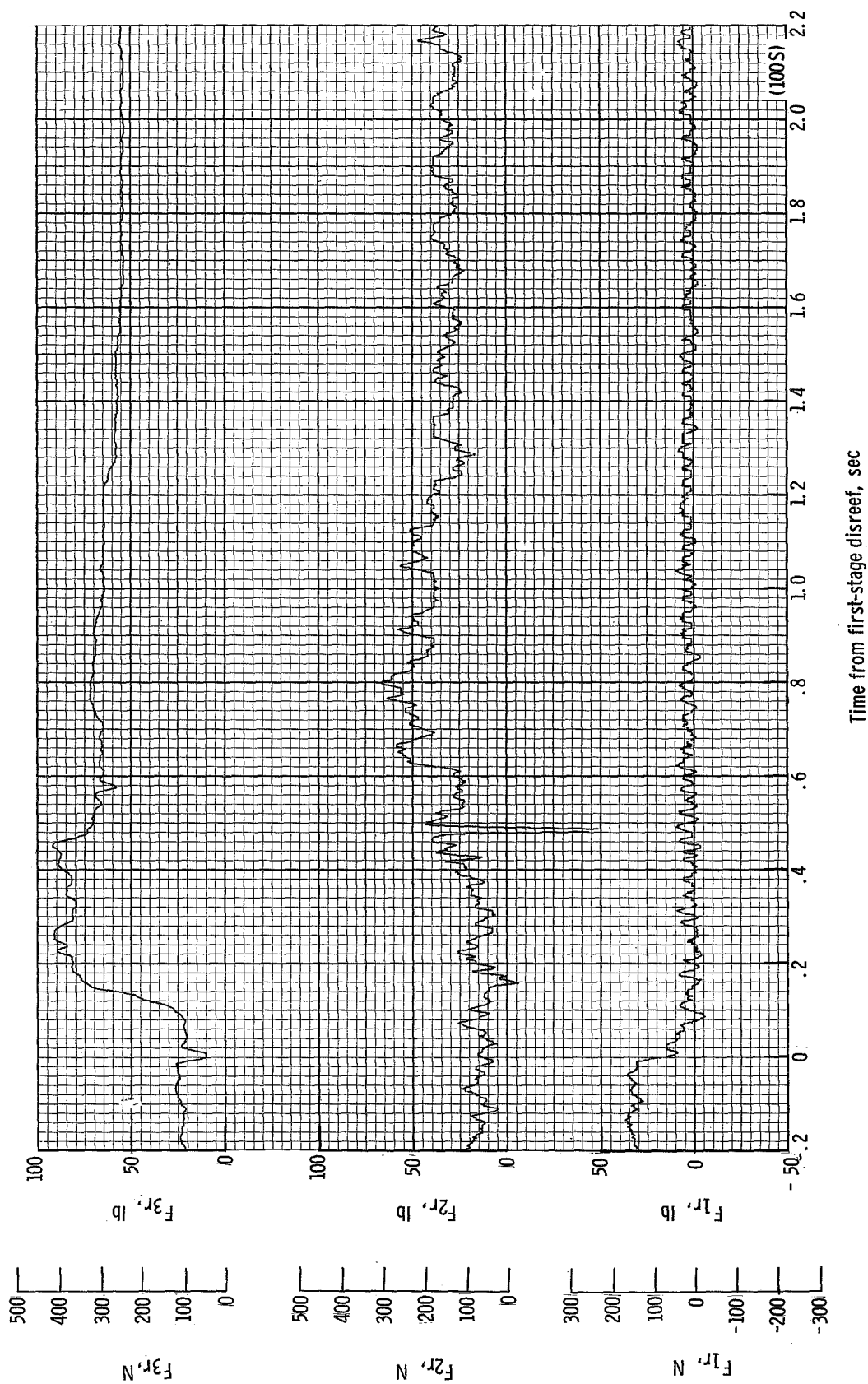
(f) Individual suspension-line loads F_{te1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from first-stage disreef. Time = 0 second corresponds to 30.25 seconds after launch.

Figure 14.- Continued.



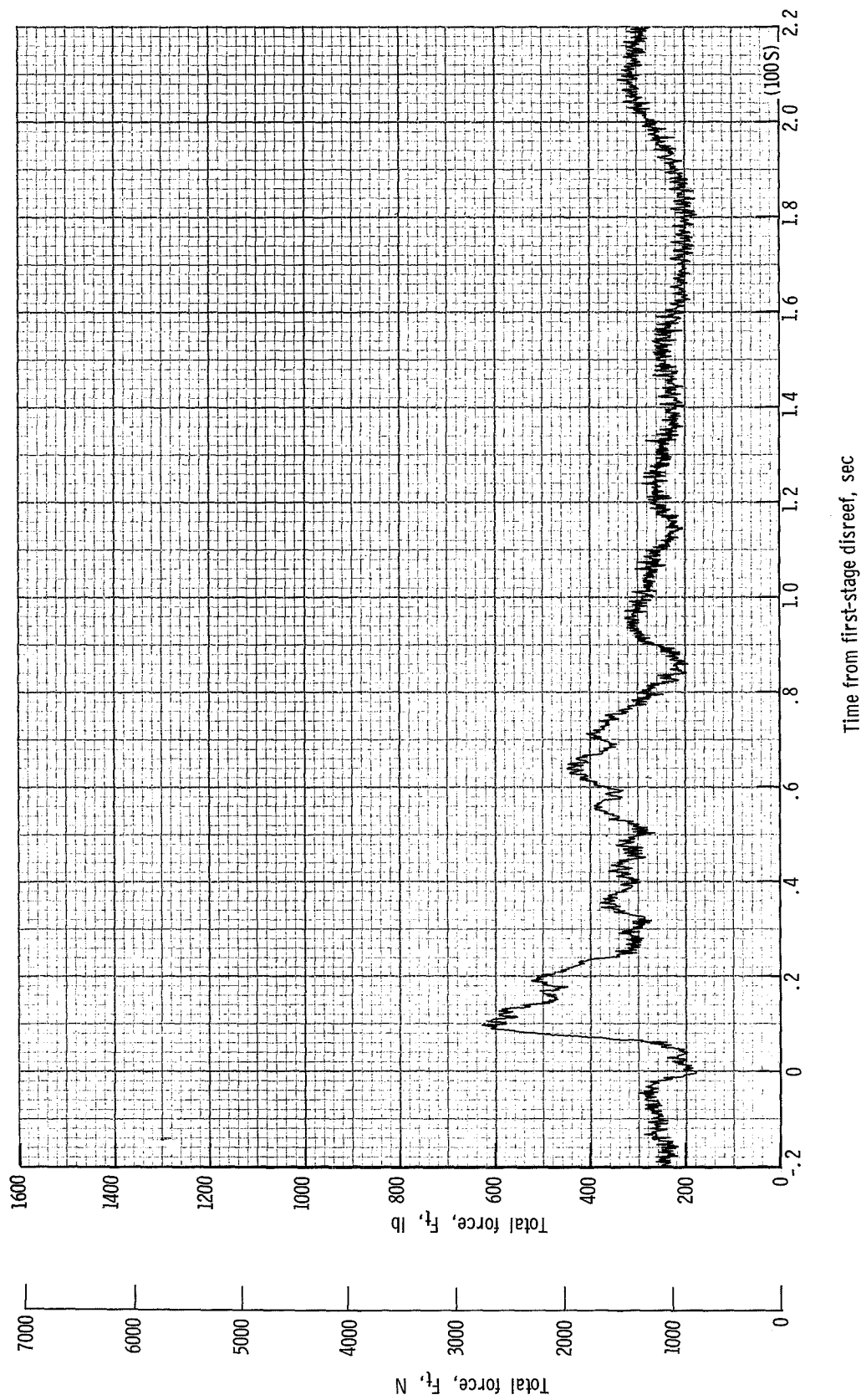
(g) Individual suspension-line loads F_{L1e1} , F_{L1e6} , and F_{L1e3} plotted against time from first-stage disreef. Time = 0 second corresponds to 30.25 seconds after launch.

Figure 14.- Continued.



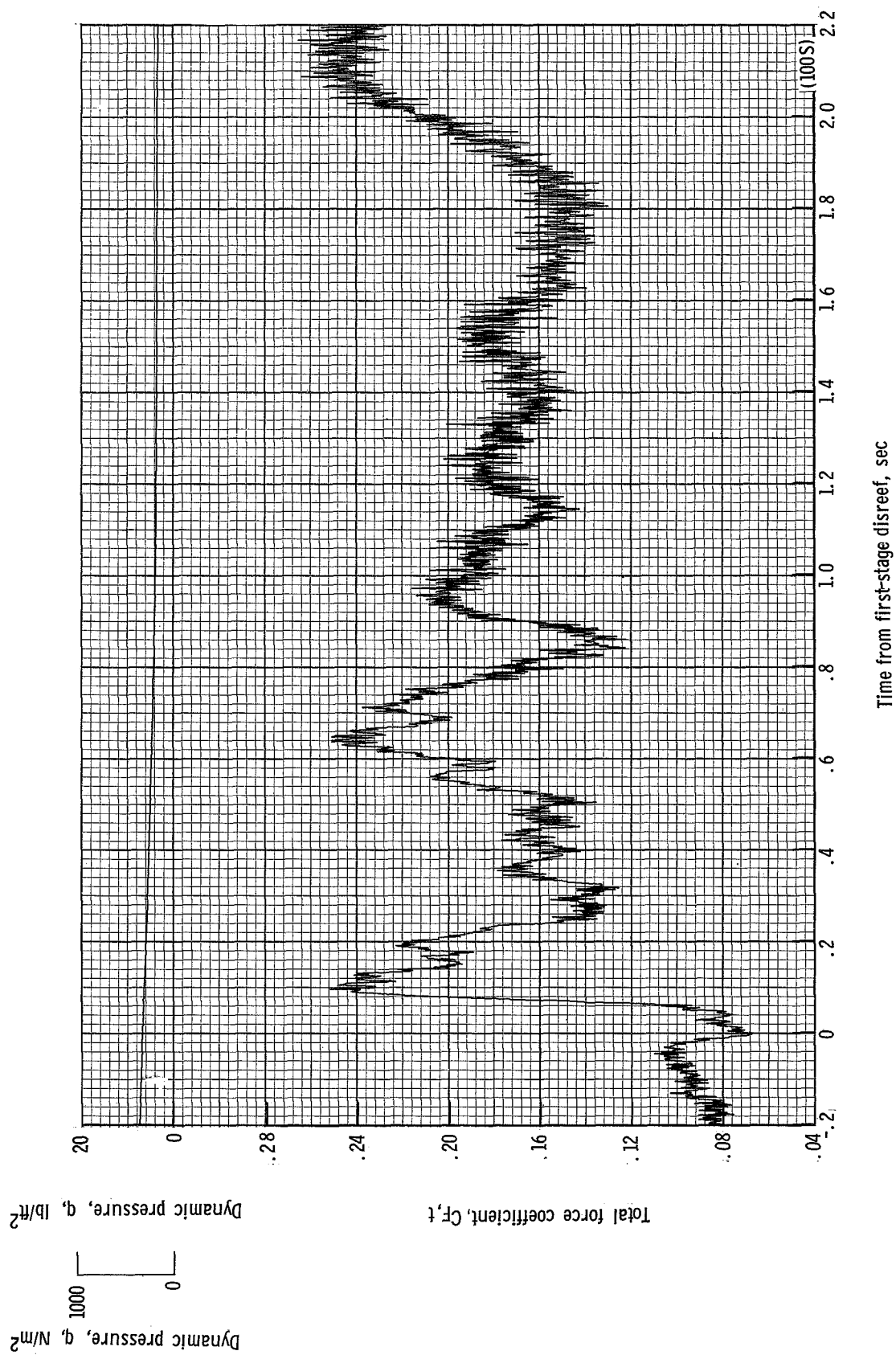
(h) Individual reefing-line loads F_{1r} , F_{2r} , and F_{3r} plotted against time from first-stage disreef. Time = 0 second corresponds to 30.25 seconds after launch.

Figure 14.- Continued.



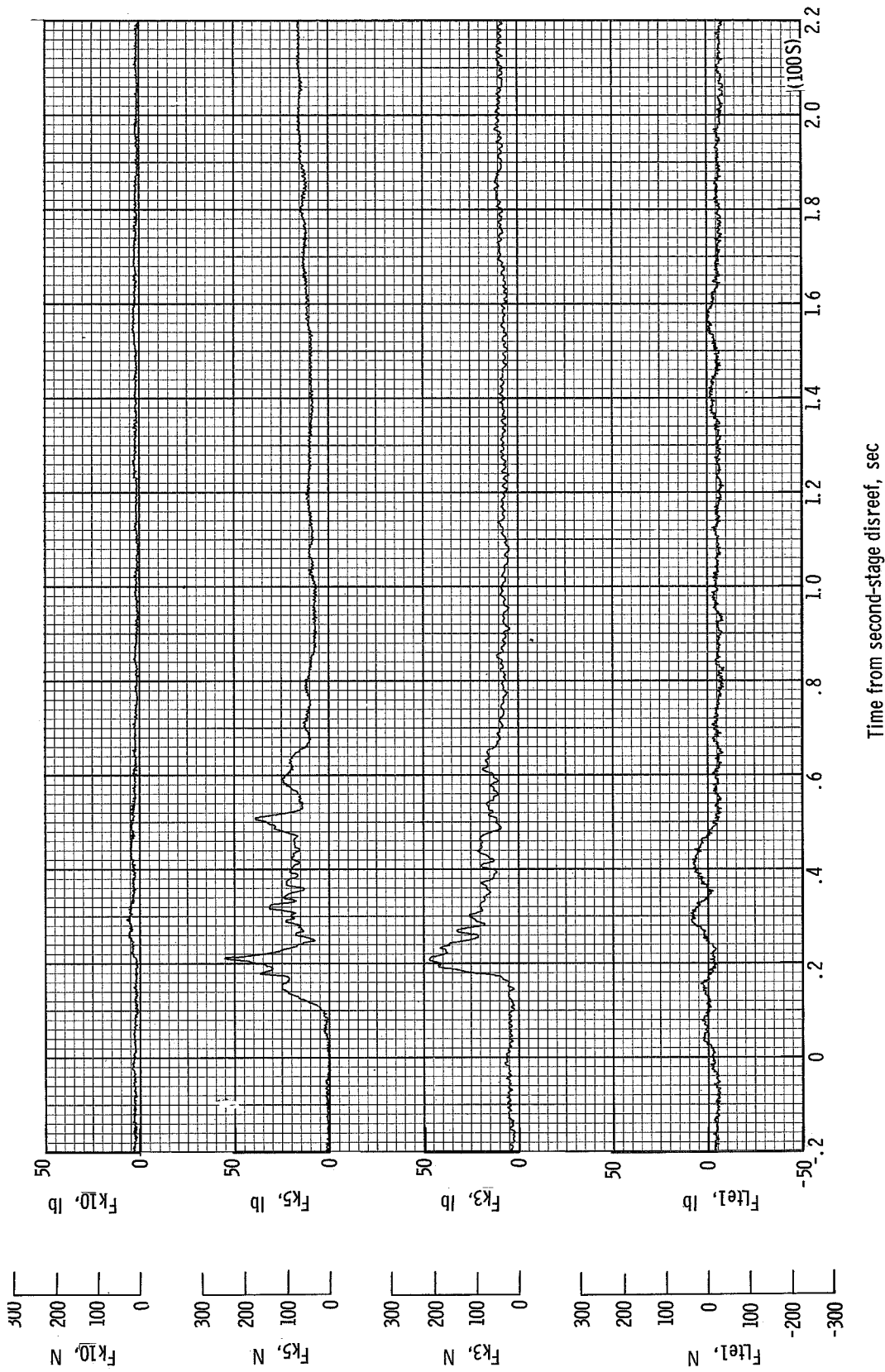
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 30.25 seconds after launch.

Figure 14. - Continued.



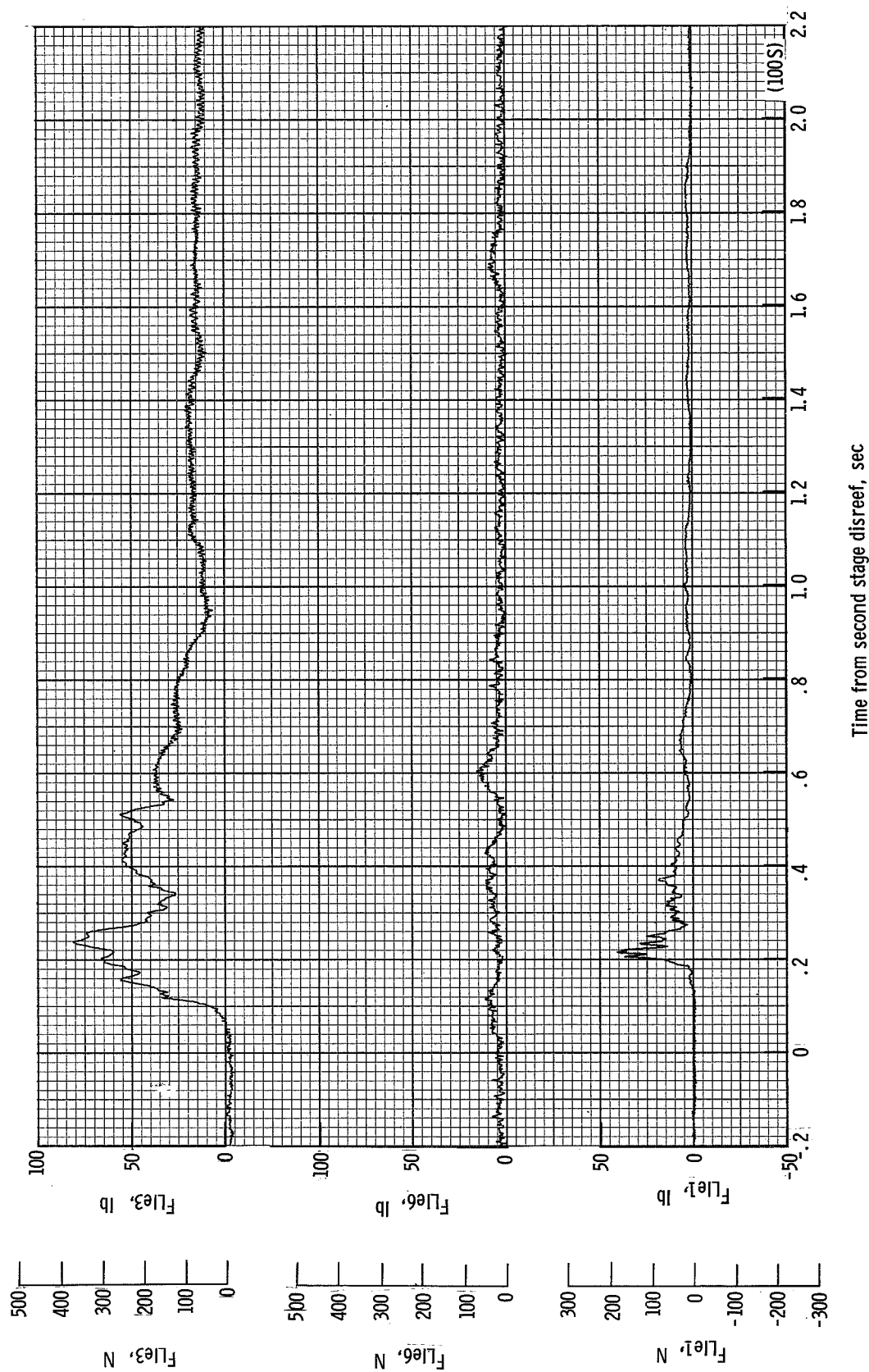
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 30.25 seconds after launch.

Figure 14.- Continued.



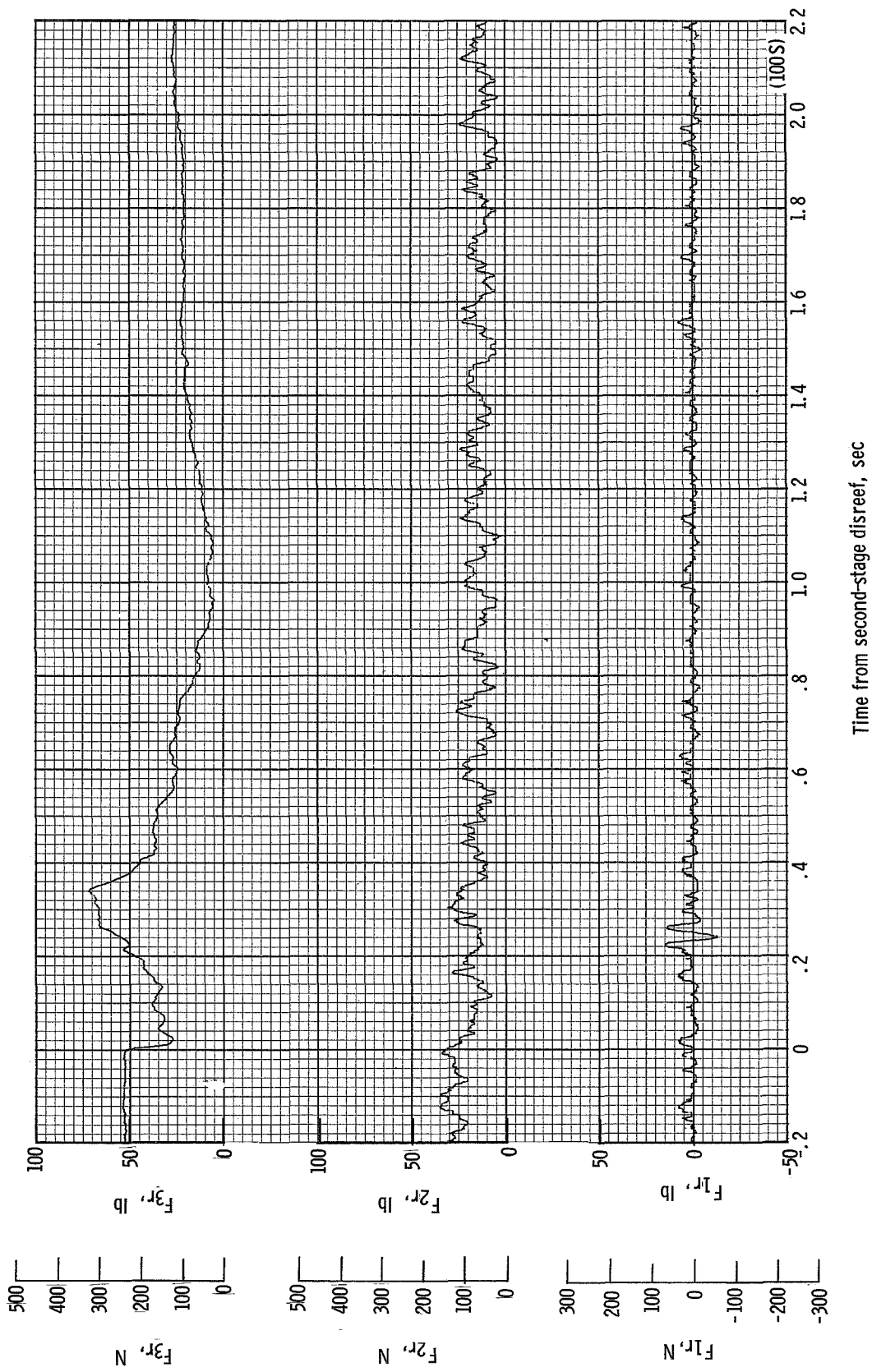
(k) Individual suspension-line loads F_{Lte1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.96 seconds after launch.

Figure 14.- Continued.



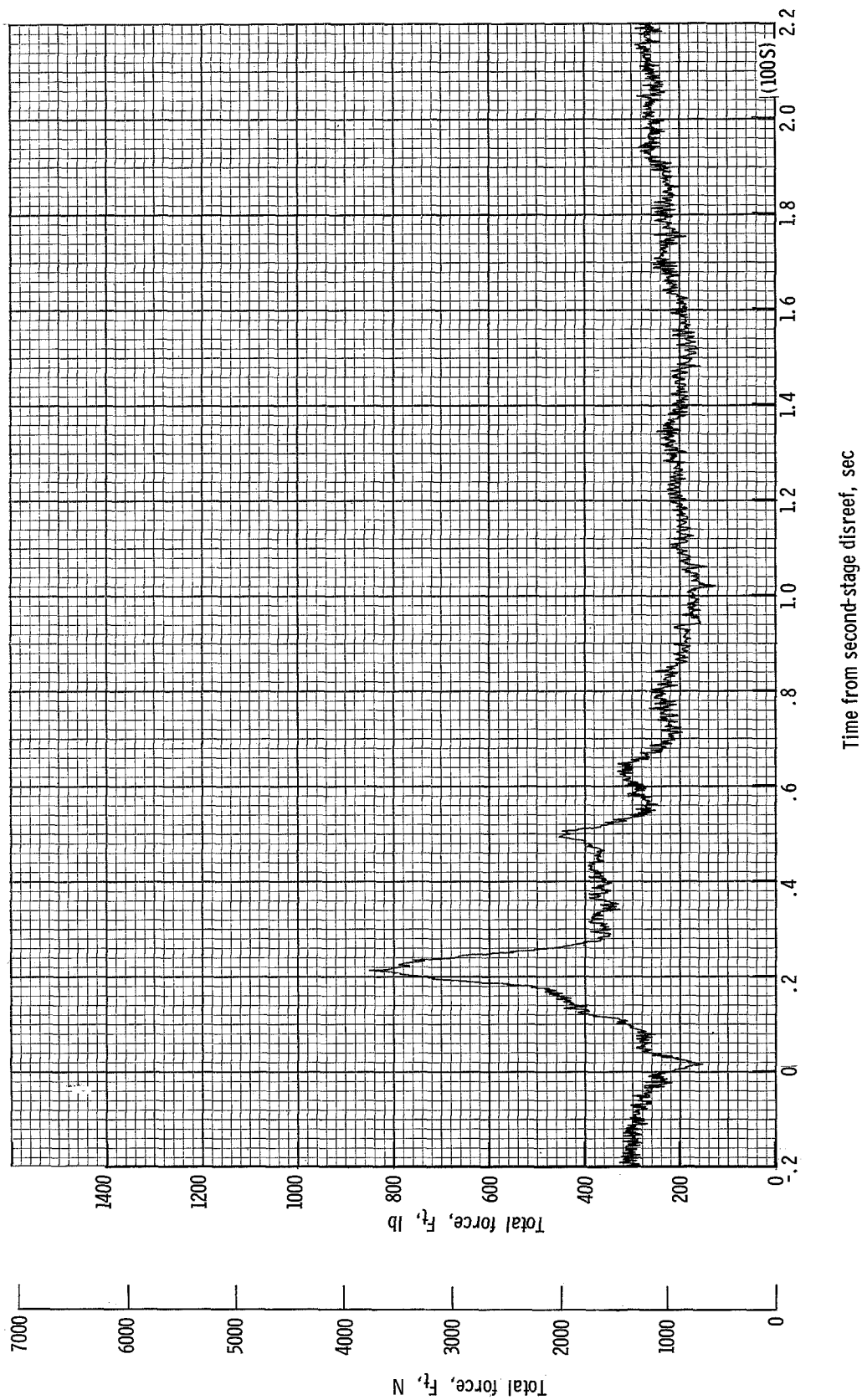
(1) Individual suspension-line loads F_{Lle1} , F_{Lle6} , and F_{Lle3} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.96 seconds after launch.

Figure 14.- Continued.



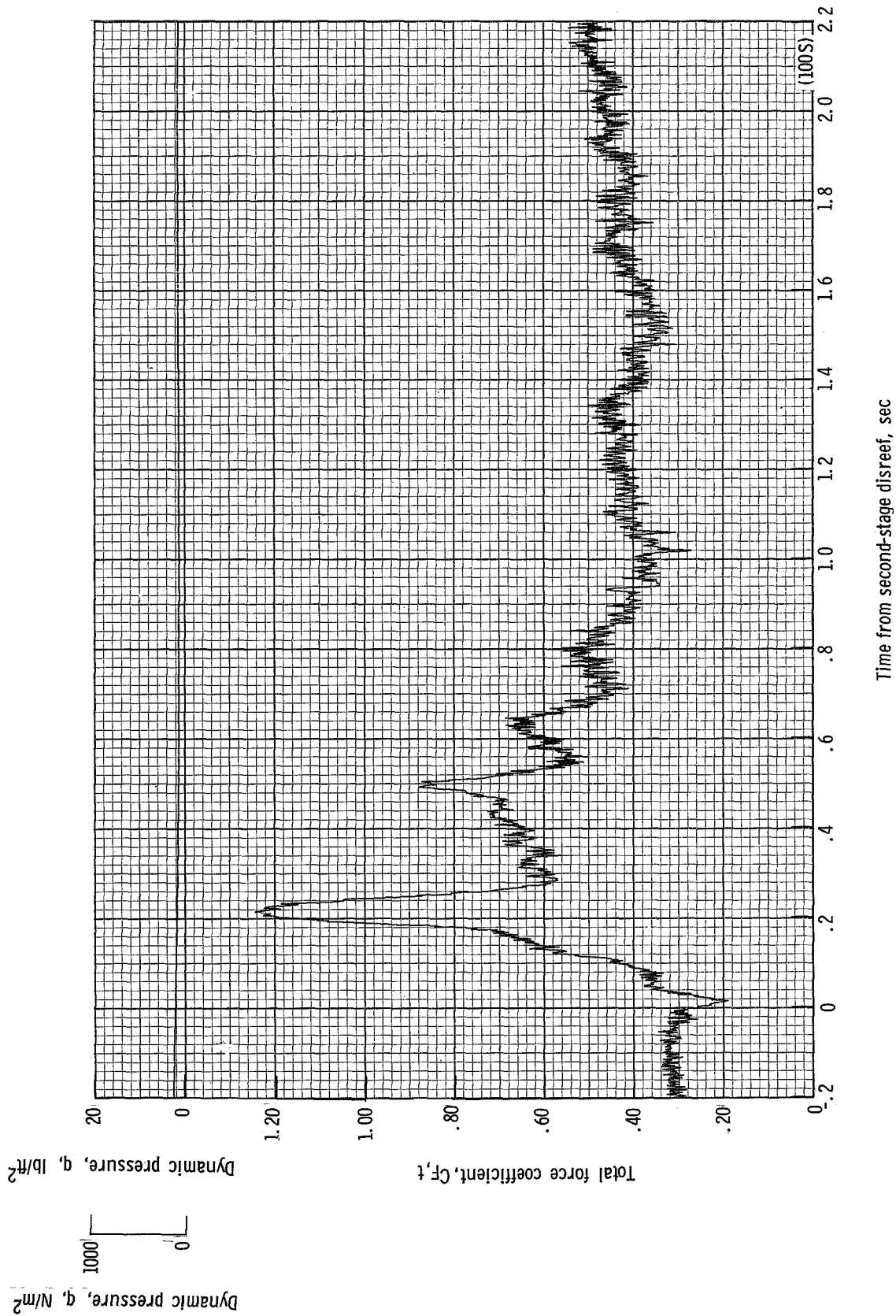
(m) Individual reefing-line loads F_{1r} , F_{2r} , and F_{3r} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.96 seconds after launch.

Figure 14.- Continued.



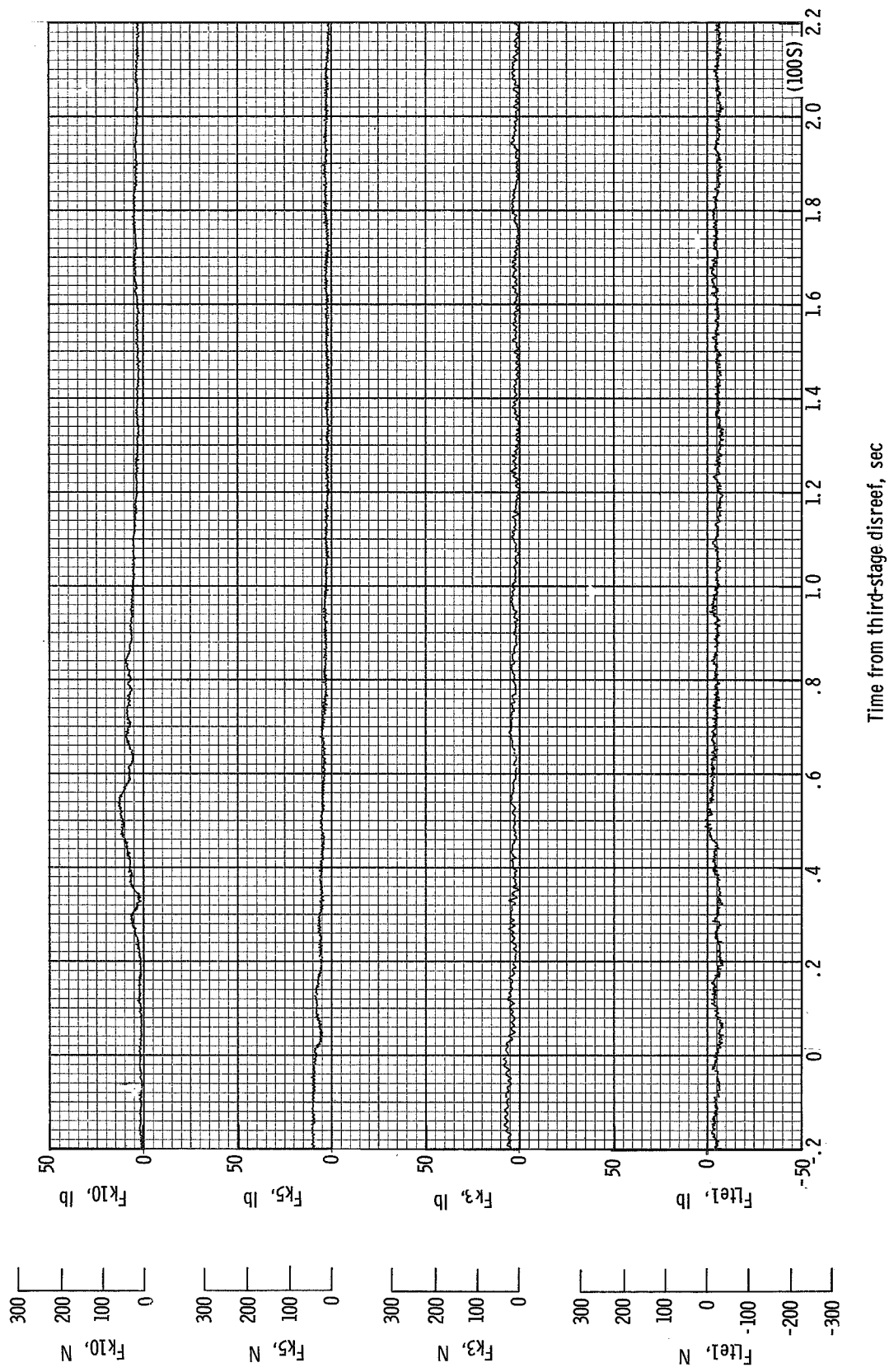
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 32.96 seconds after launch.

Figure 14.- Continued.



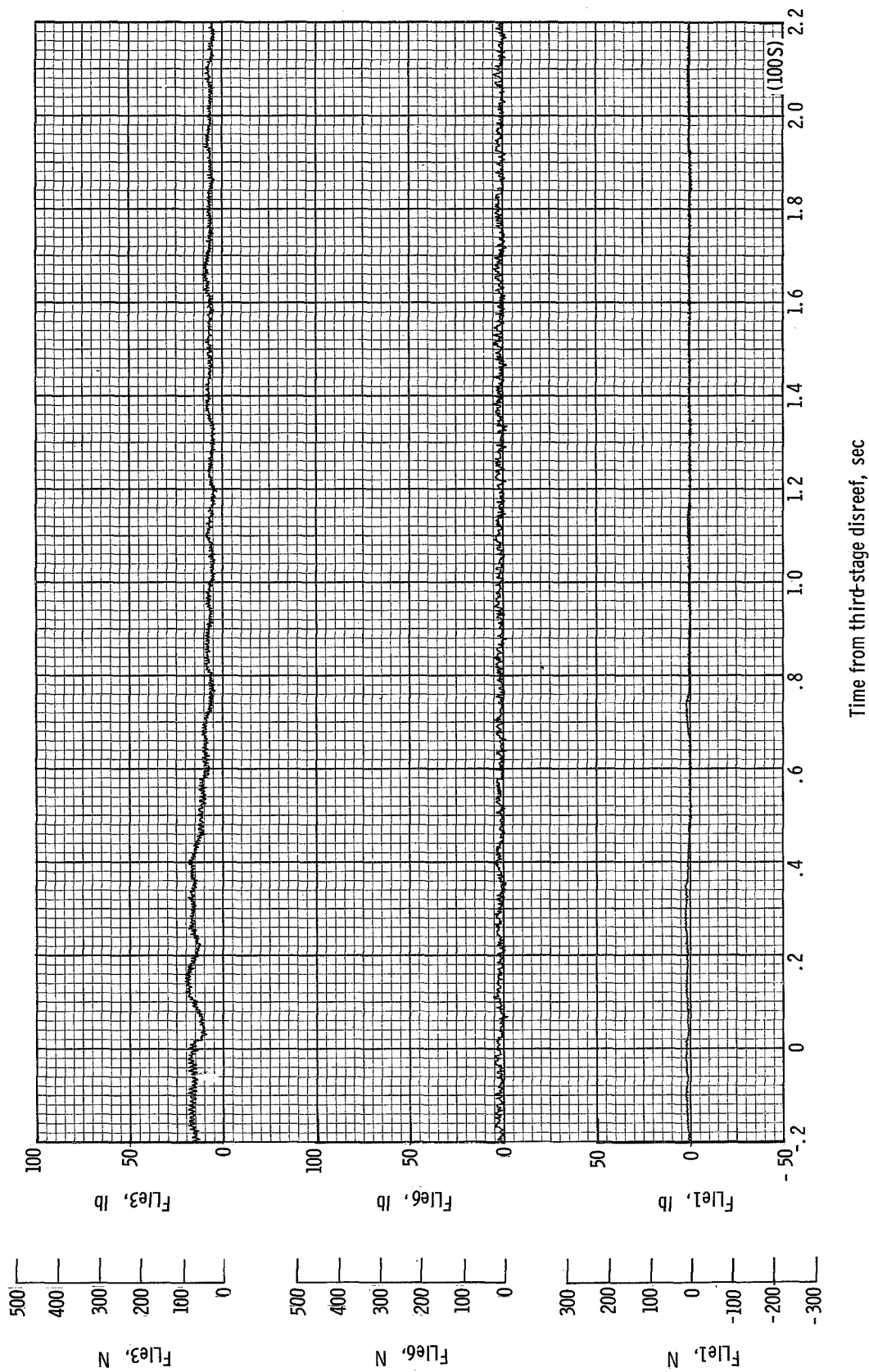
(c) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 32.96 seconds after launch.

Figure 14.- Continued.



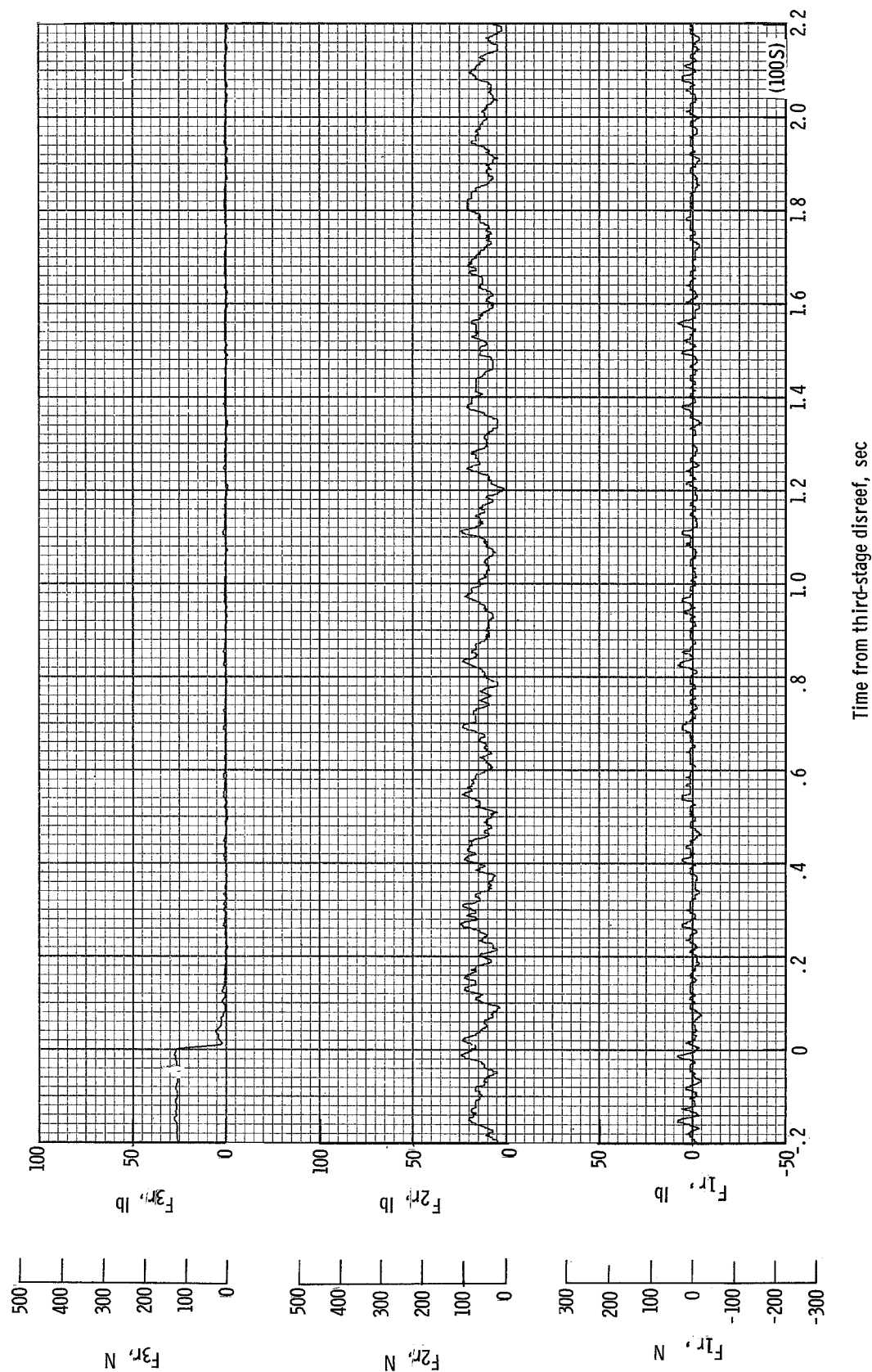
(p) Individual suspension-line loads F_{Lte1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.48 seconds after launch.

Figure 14.- Continued.



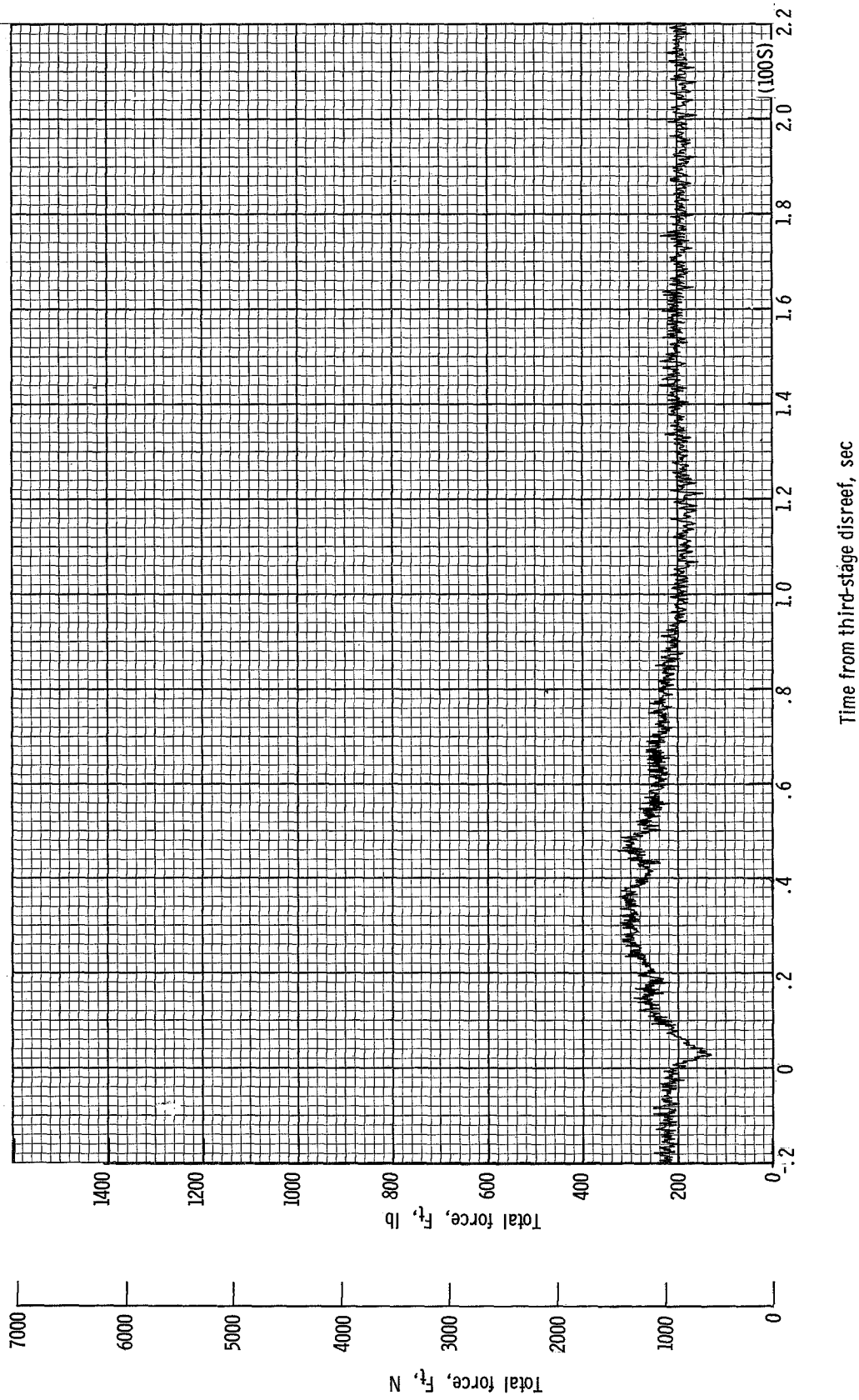
(q) Individual suspension-line loads F_{L1} , F_{L6} , and F_{L3} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.48 seconds after launch.

Figure 14.- Continued.



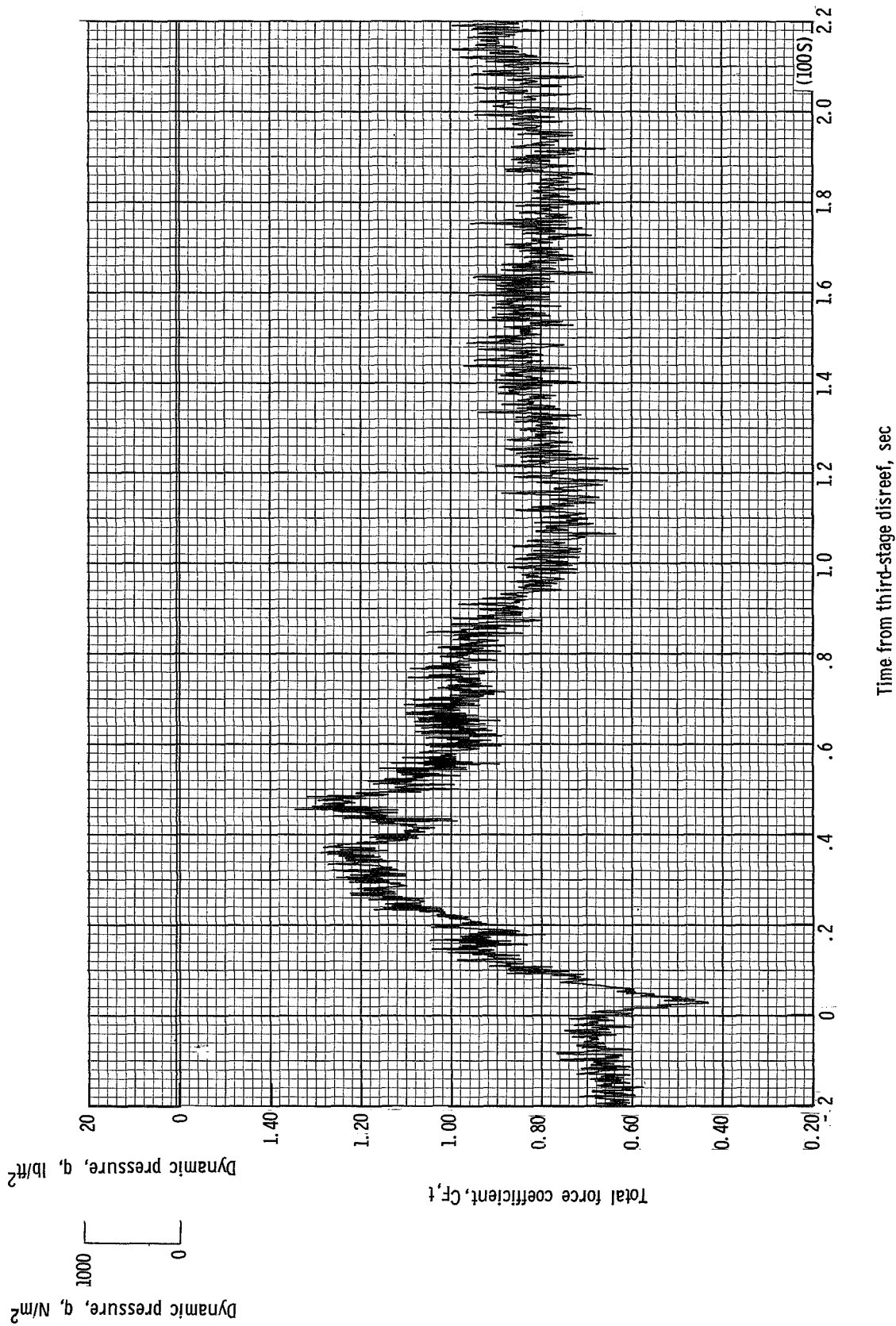
(r) Individual reefing-line loads F_{1r} , F_{2r} , and F_{3r} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.48 seconds after launch.

Figure 14.- Continued.



(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.48 seconds after launch.

Figure 14.- Continued.



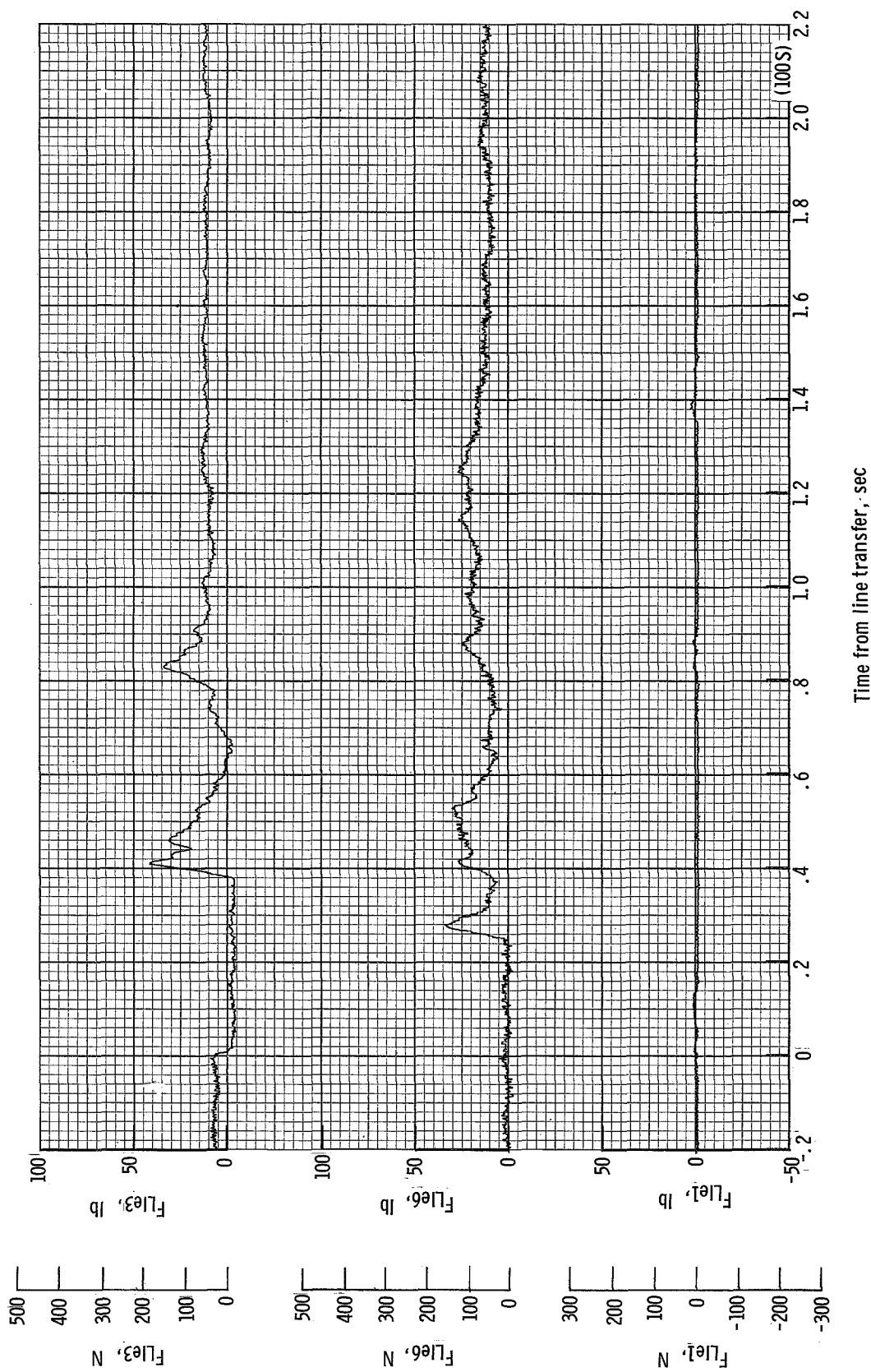
(t) Total-force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.48 seconds after launch.

Figure 14.- Continued.



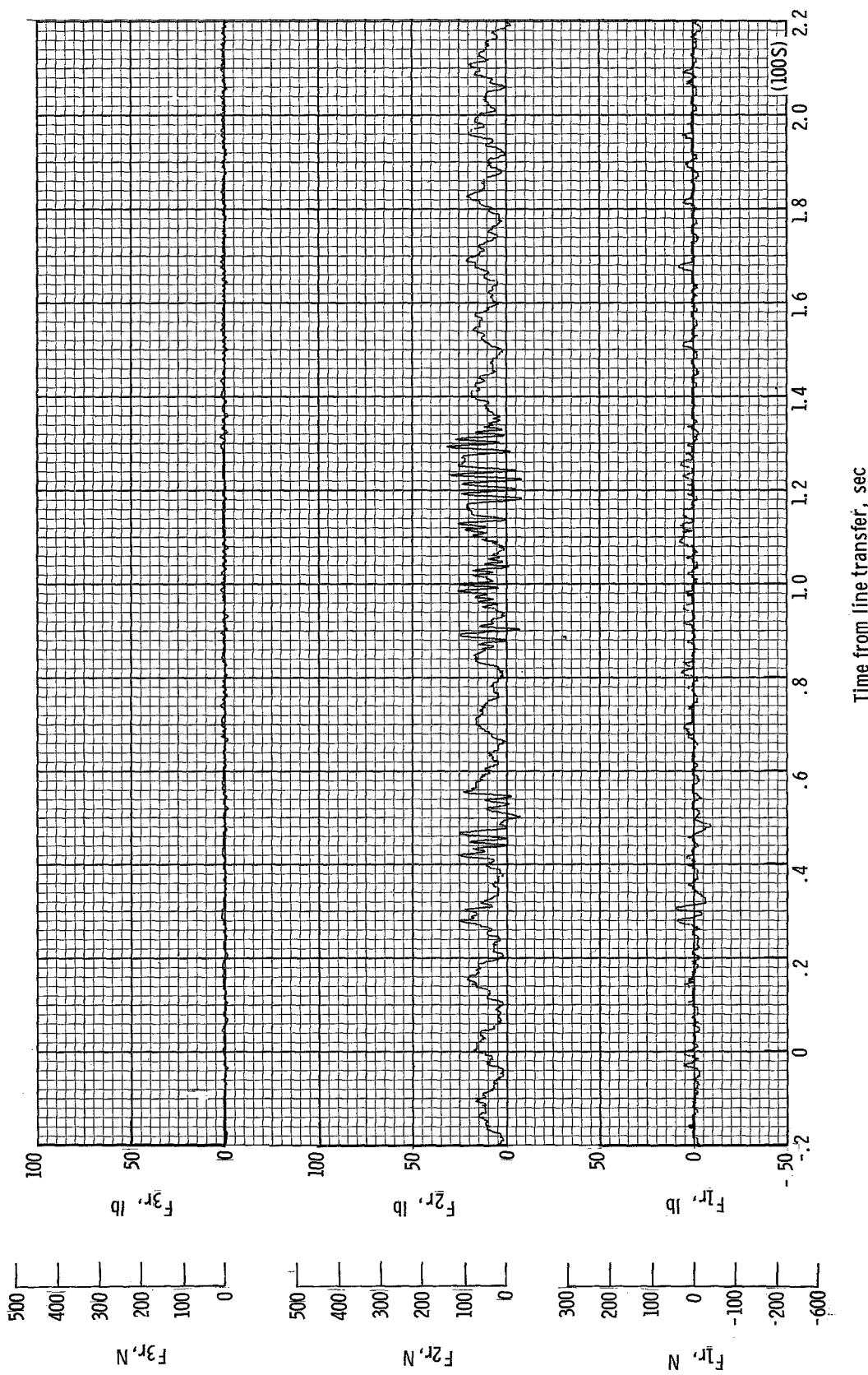
(u) Individual suspension-line loads F_{tel1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from line transfer. Time = 0 second corresponds to 39.27 seconds after launch.

Figure 14.- Continued.



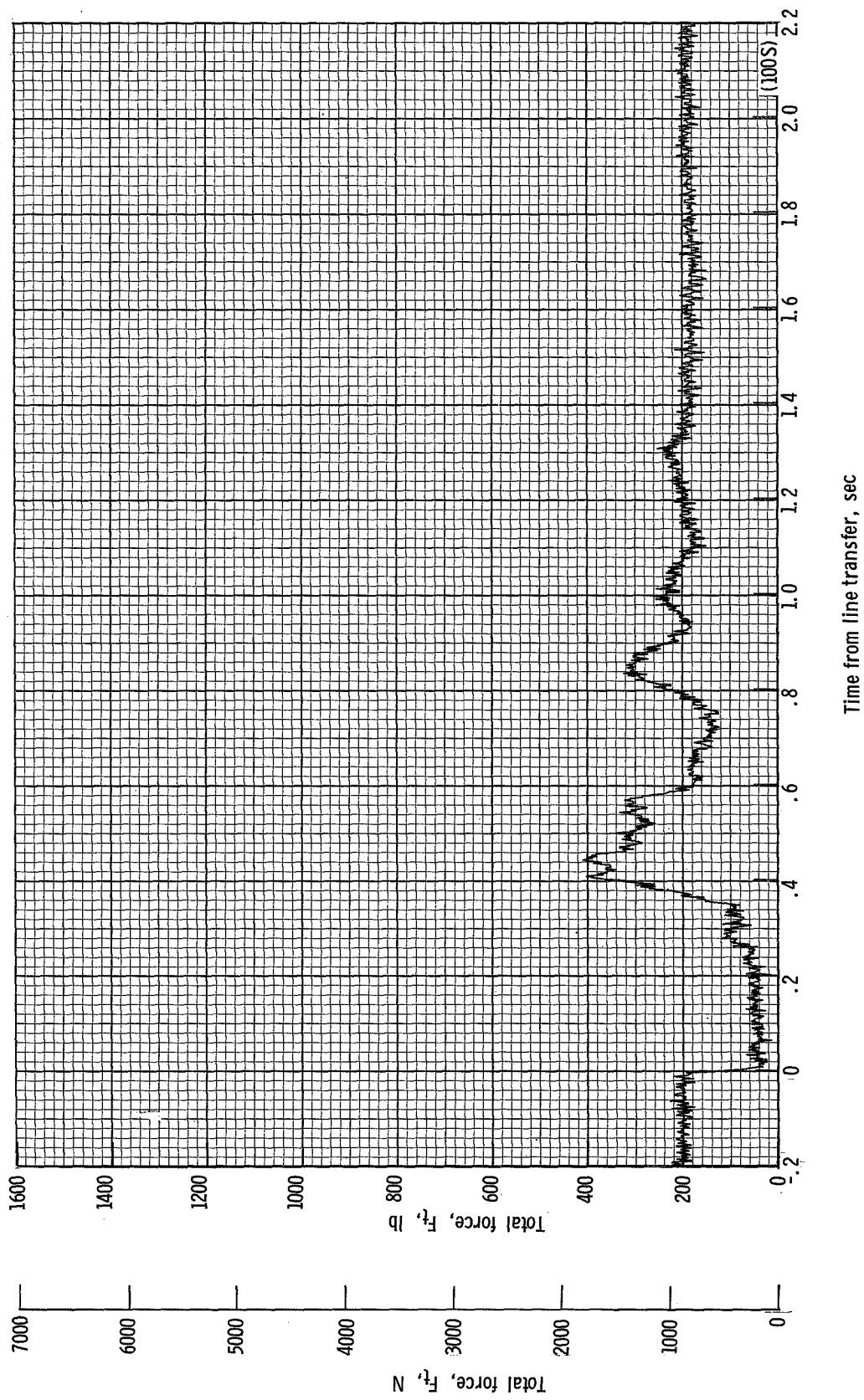
(v) Individual suspension-line loads F_{L1} , F_{L6} , and F_{L3} plotted against time from line transfer. Time = 0 second corresponds to 39.27 seconds after launch.

Figure 14.- Continued.



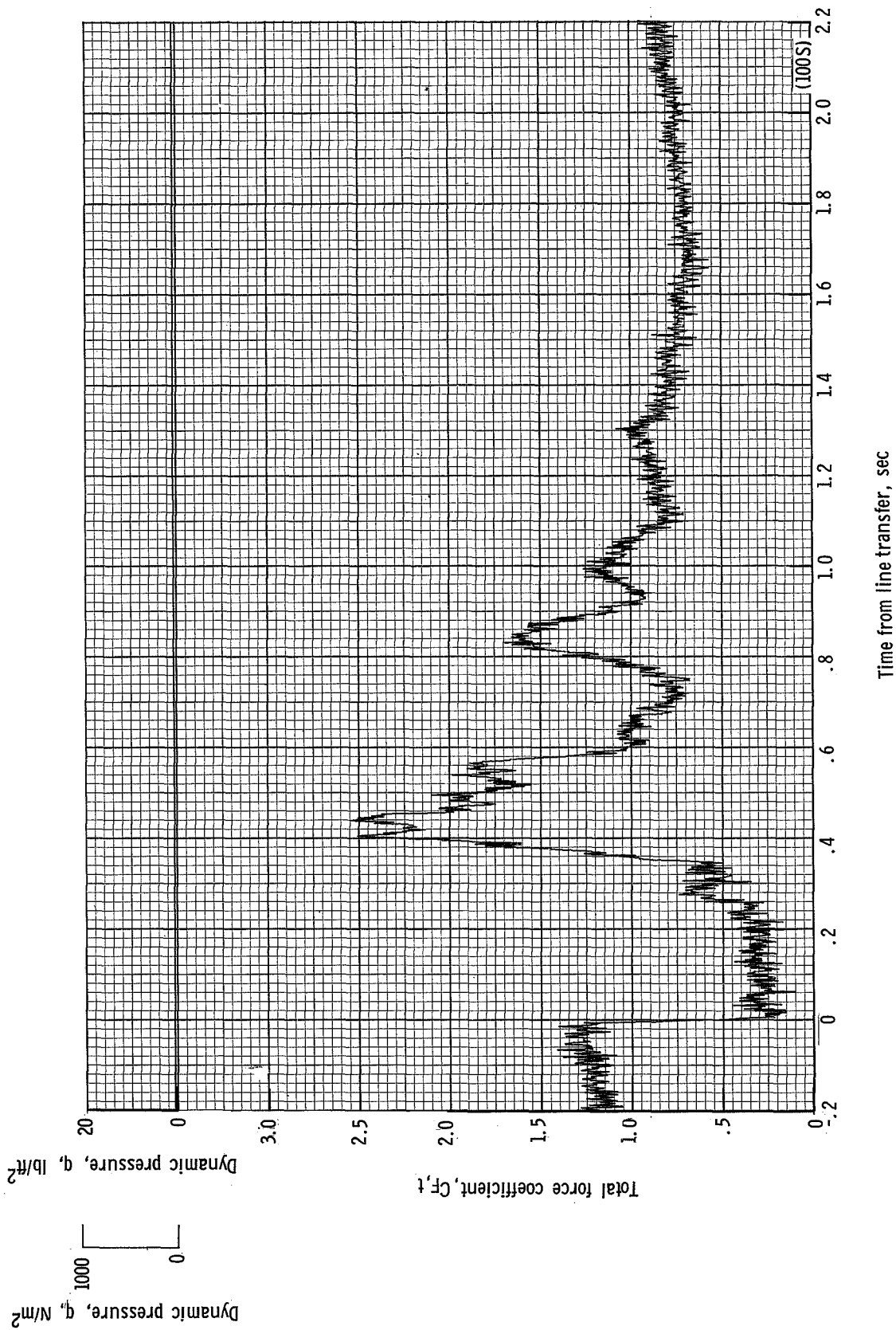
(w) Individual reefing-line loads F_{1r} , F_{2r} , and F_{3r} plotted against time from line transfer. Time = 0 second corresponds to 39.27 seconds after launch.

Figure 14.- Continued.



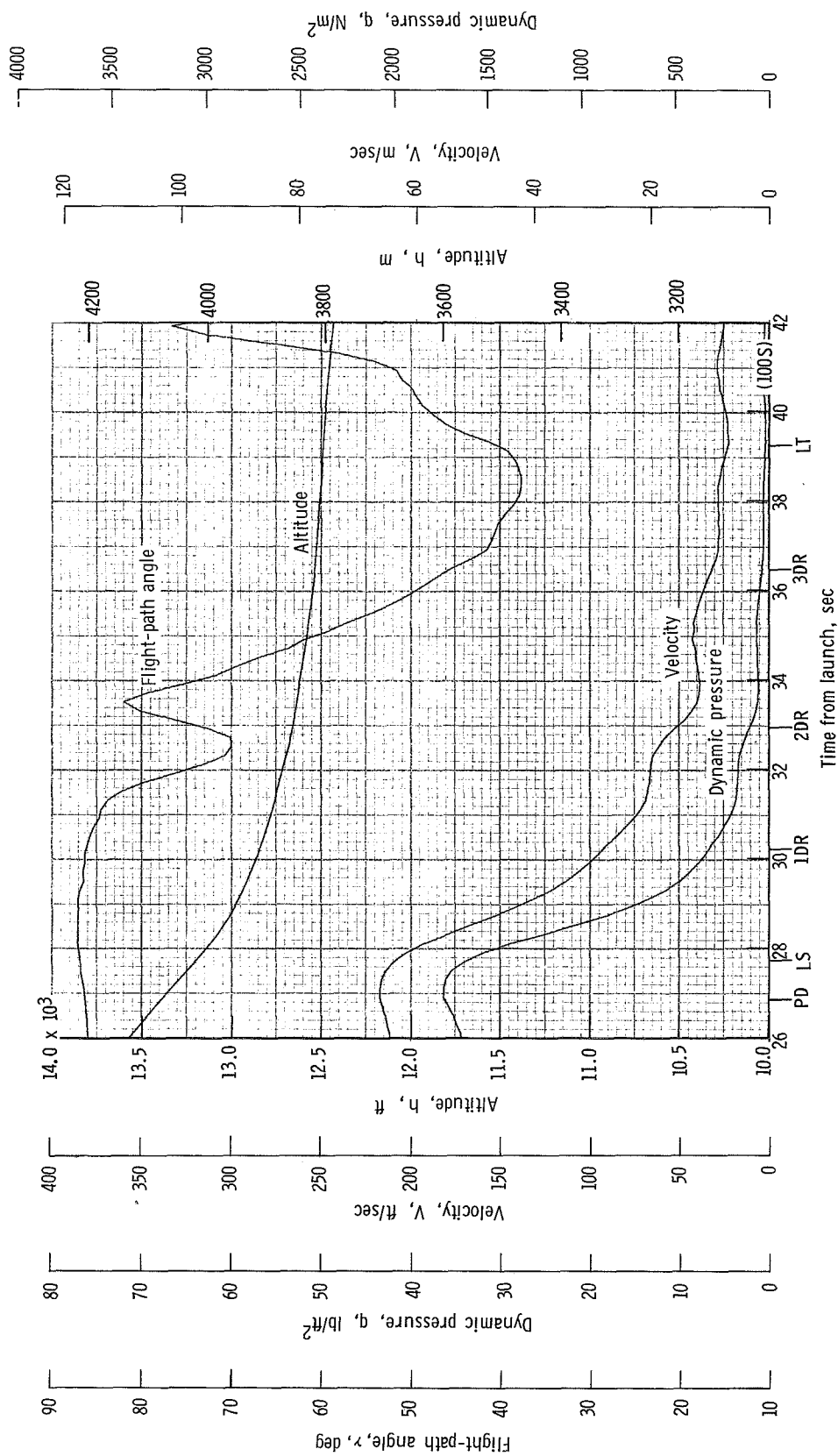
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 39.27 seconds after launch.

Figure 14.- Continued.



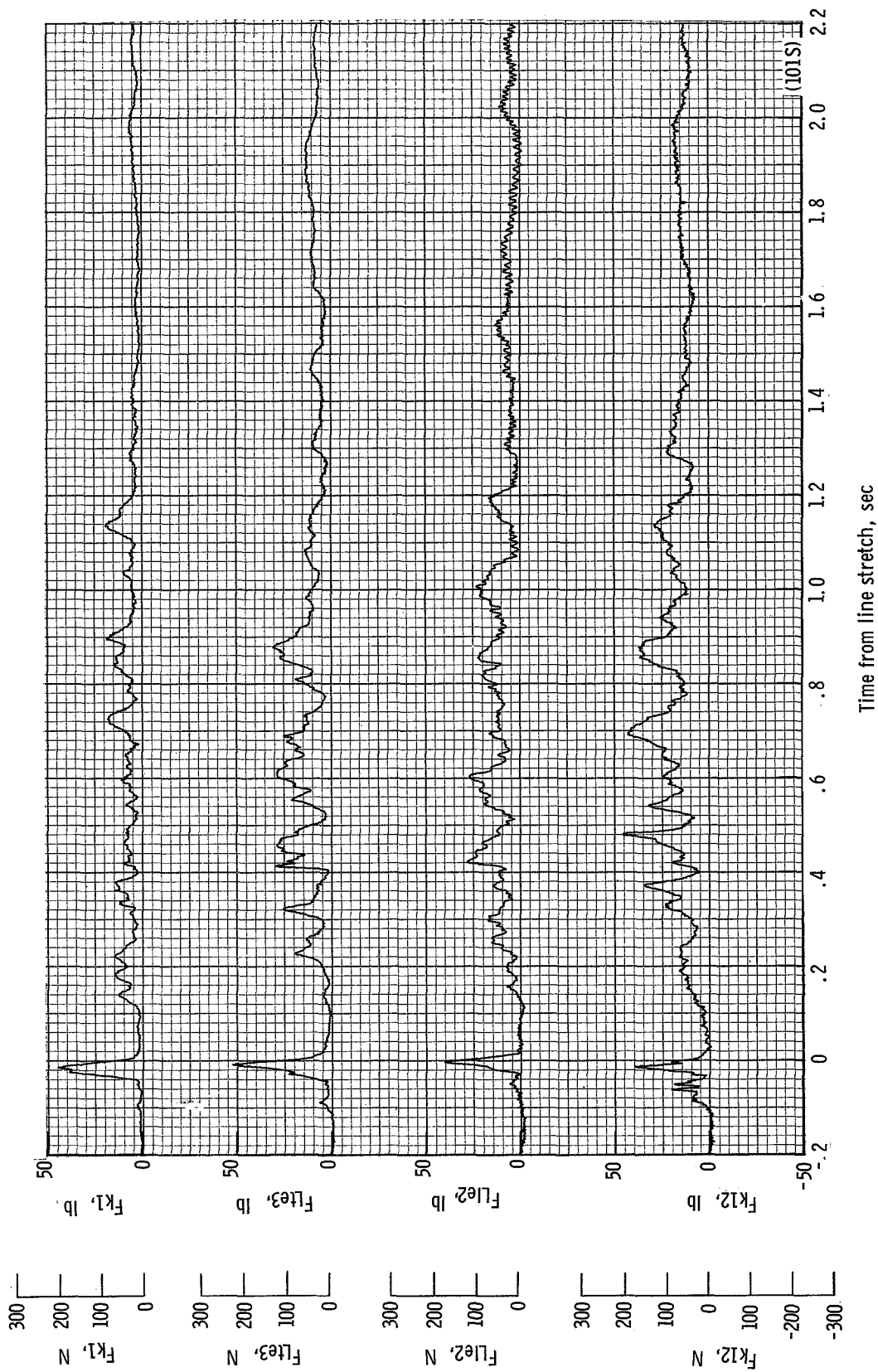
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 39.27 seconds after launch.

Figure 14.- Continued.



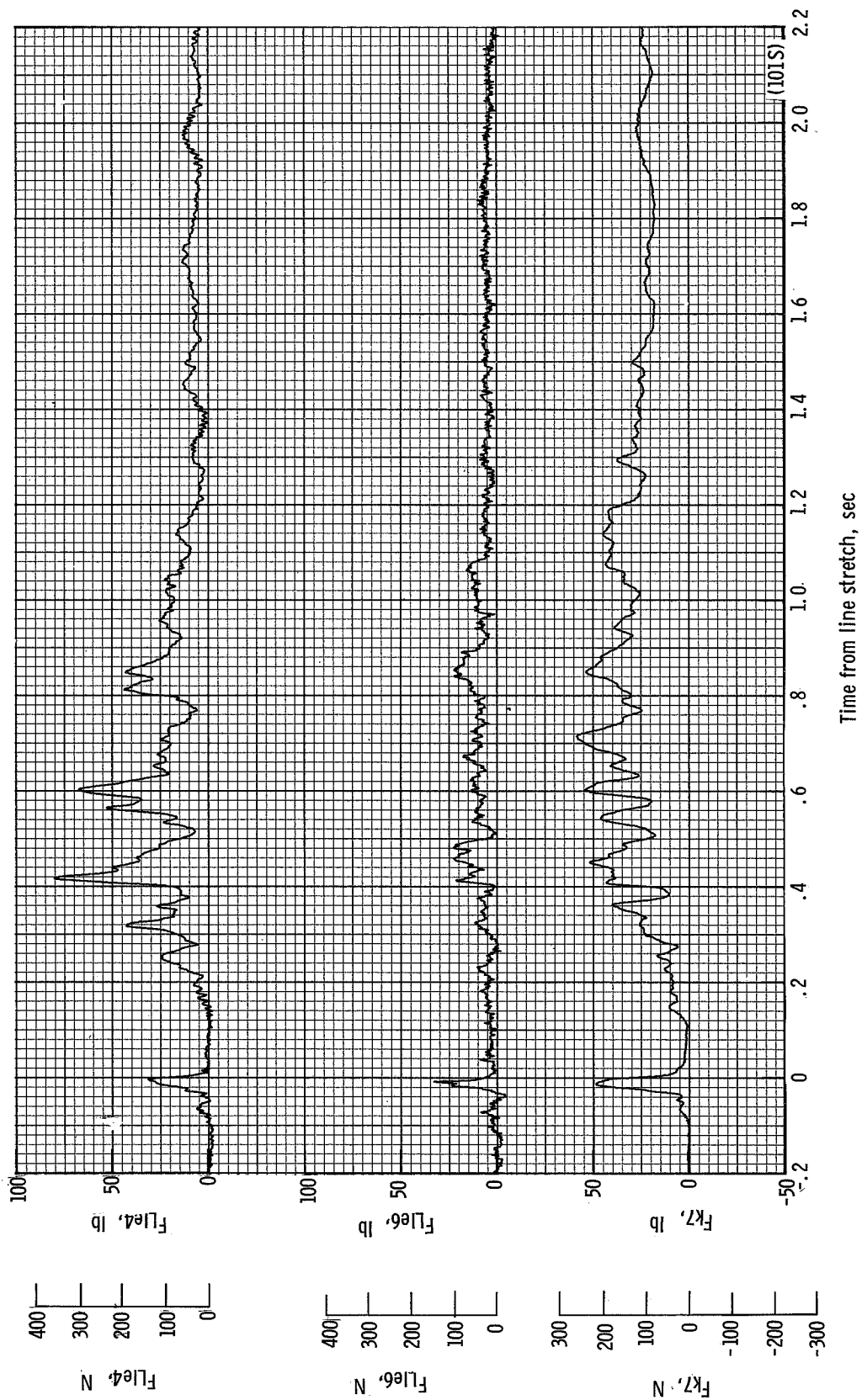
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 14.- Concluded.



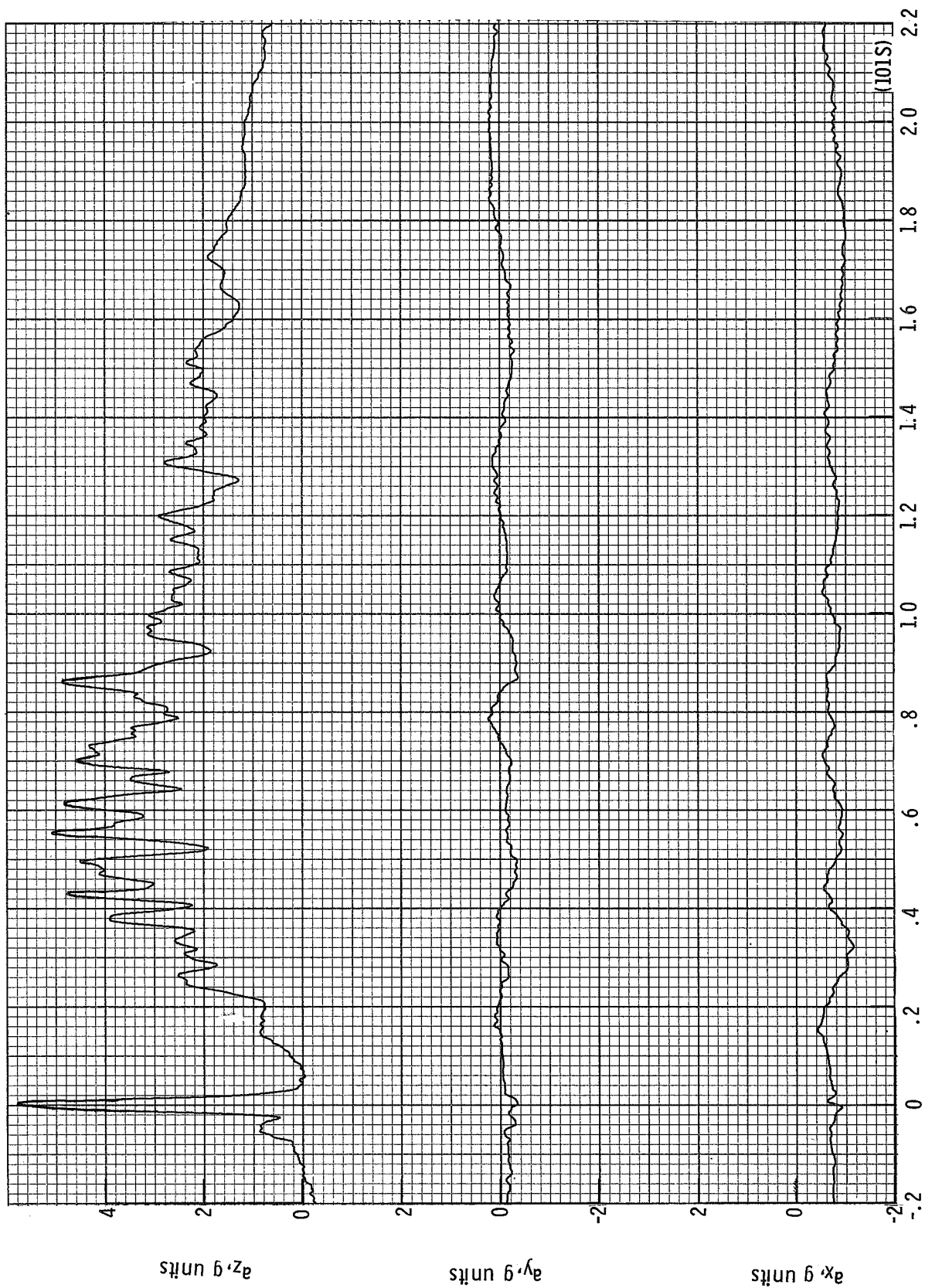
(a) Individual suspension-line loads F_{k12} , F_{k1e2} , F_{k1e3} , and F_{k1} plotted against time from line stretch. Time = 0 second corresponds to 27.13 seconds after launch.

Figure 15.- Time history of single-keel parawing deployment data for test 101S. $W_D = 934.1$ N (210.0 lb); $W_P = 797.2$ N (179.2 lb); $q_{PD} = 1757.2$ N/m² (36.7 lb/ft²); $h_{PD} = 4075$ m (13 370 ft); $t_r/t_k = 0.116$; reeling version III.



(b) Individual suspension-line loads F_{k7} , F_{Lle6} and F_{Lle4} plotted against time from line stretch. Time = 0 second corresponds to 27.13 seconds after launch.

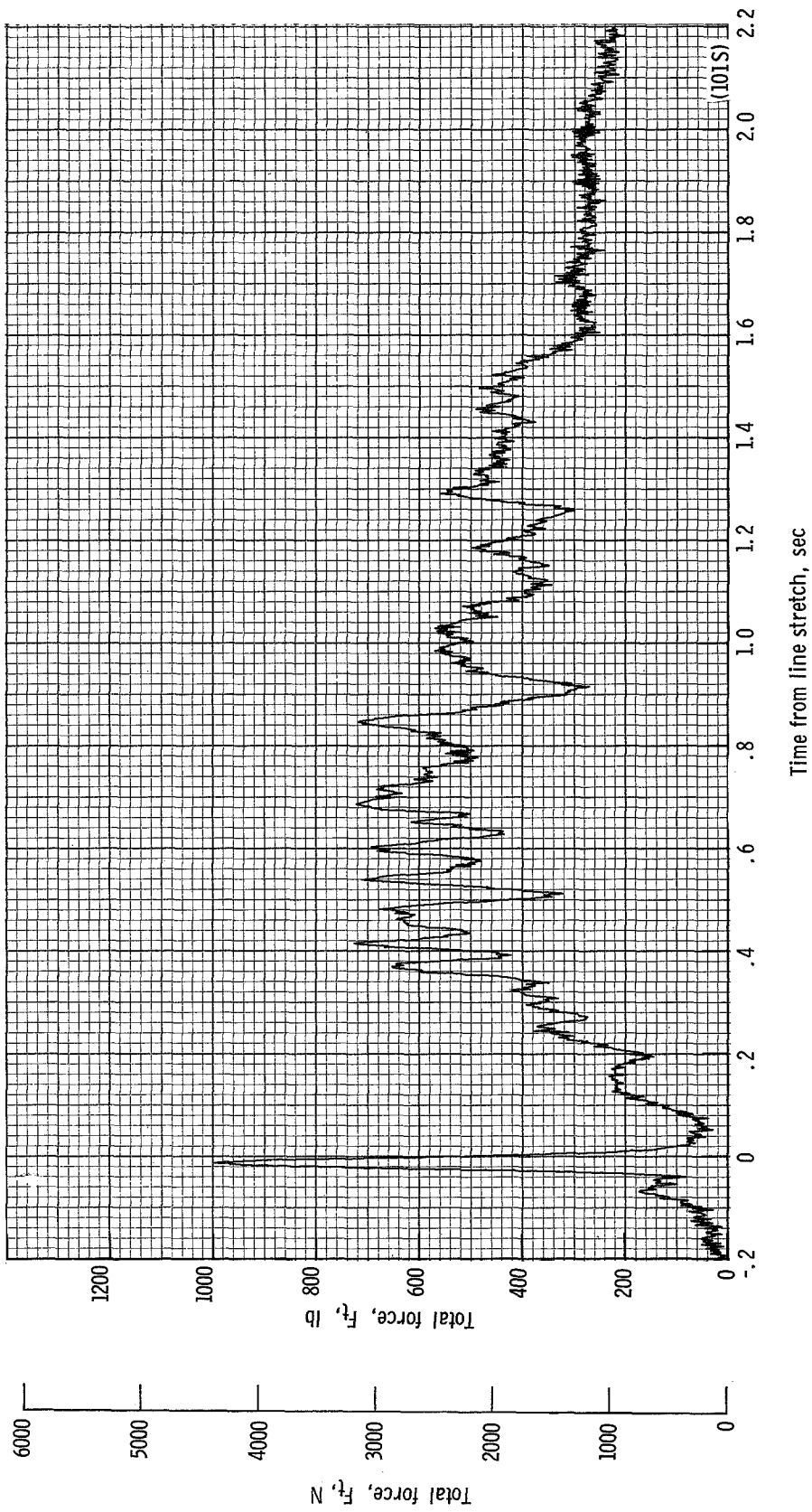
Figure 15.- Continued.



Time from line stretch, sec

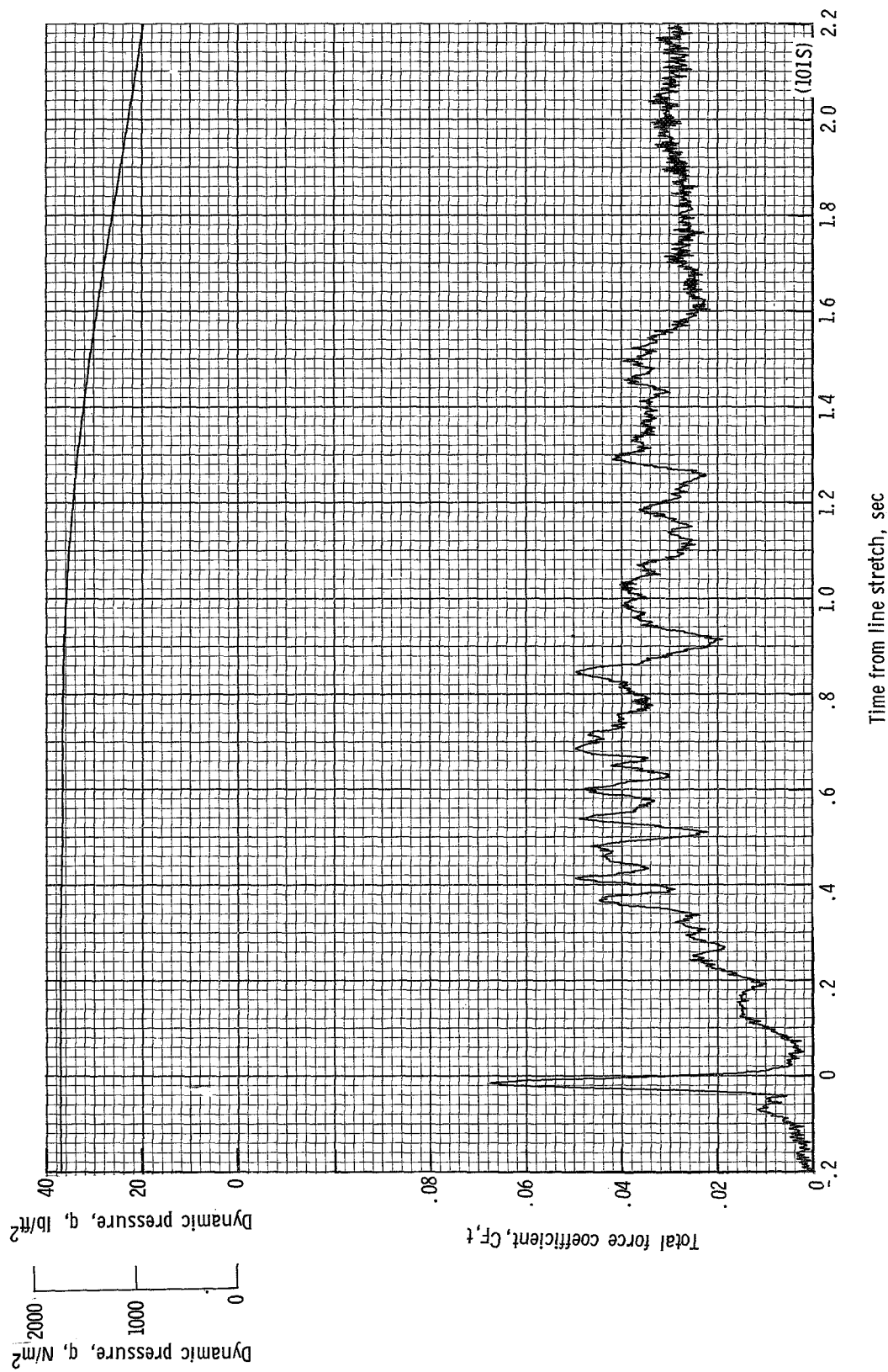
(c) Accelerations a_x , a_y , and a_z plotted against time from line stretch. Time = 0 second corresponds to 27.13 seconds after launch.

Figure 15.- Continued.



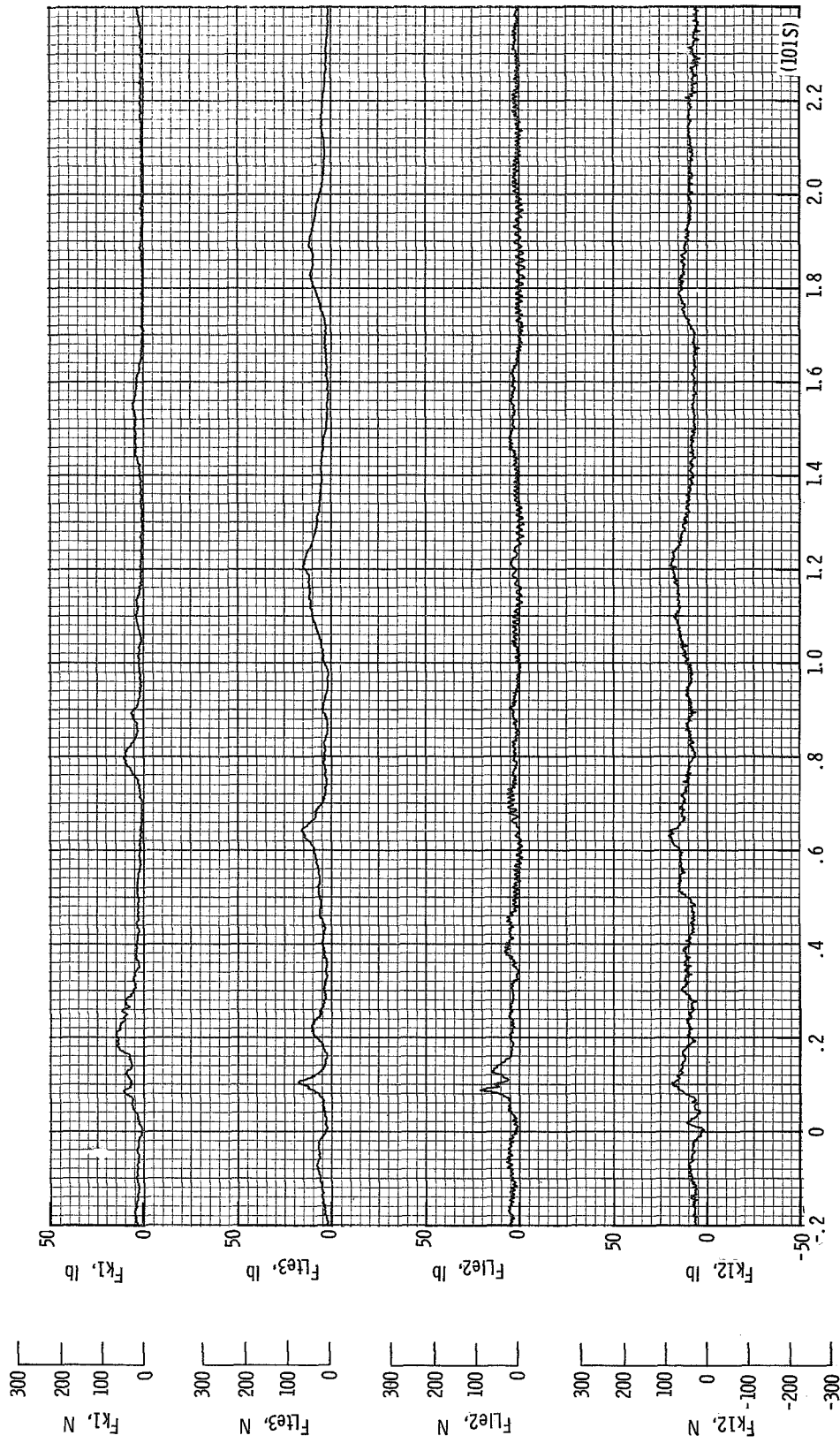
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 27.13 seconds after launch.

Figure 15.- Continued.



(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 27.13 seconds after launch.

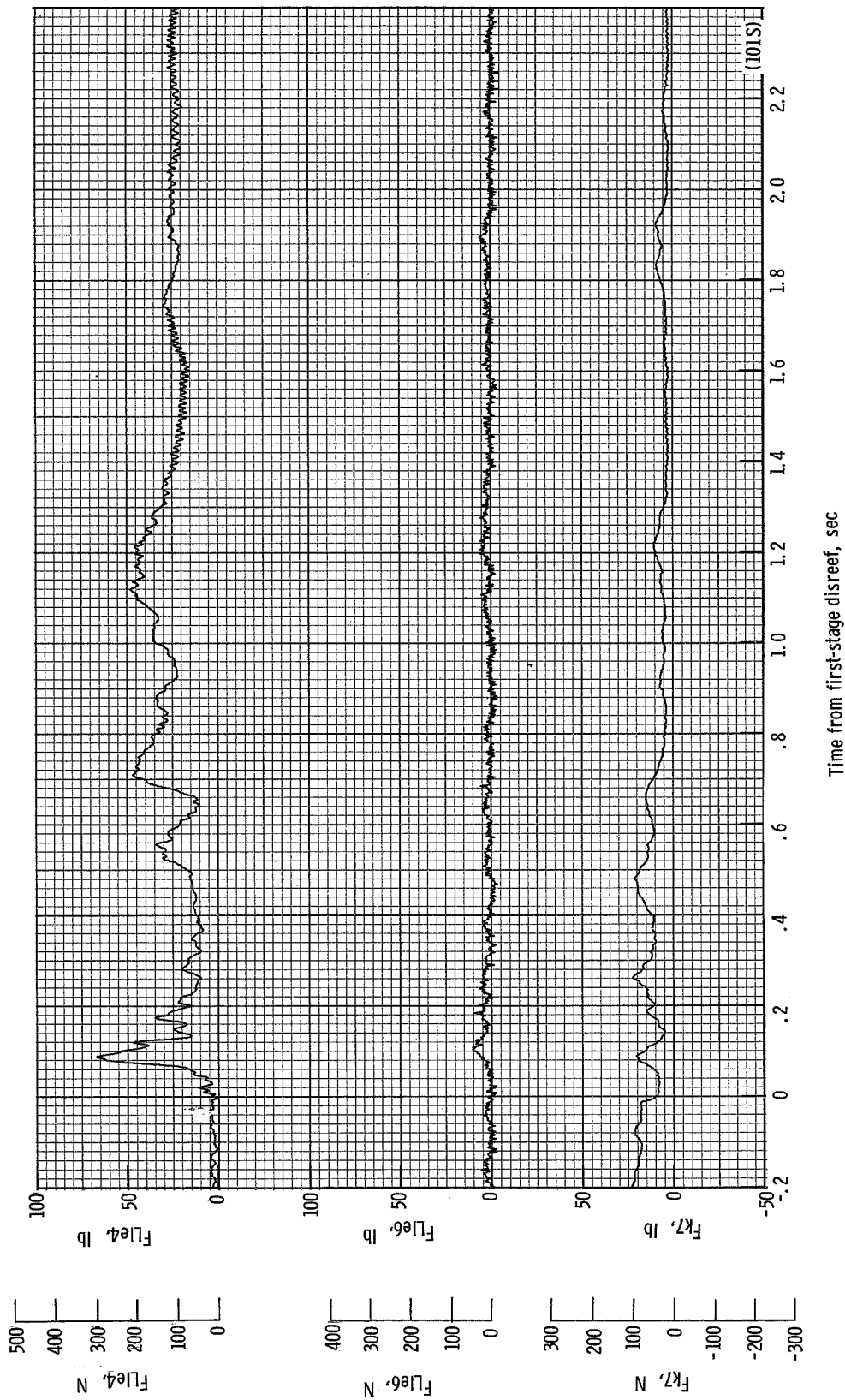
Figure 15.- Continued.



Time from first-stage disreef, sec

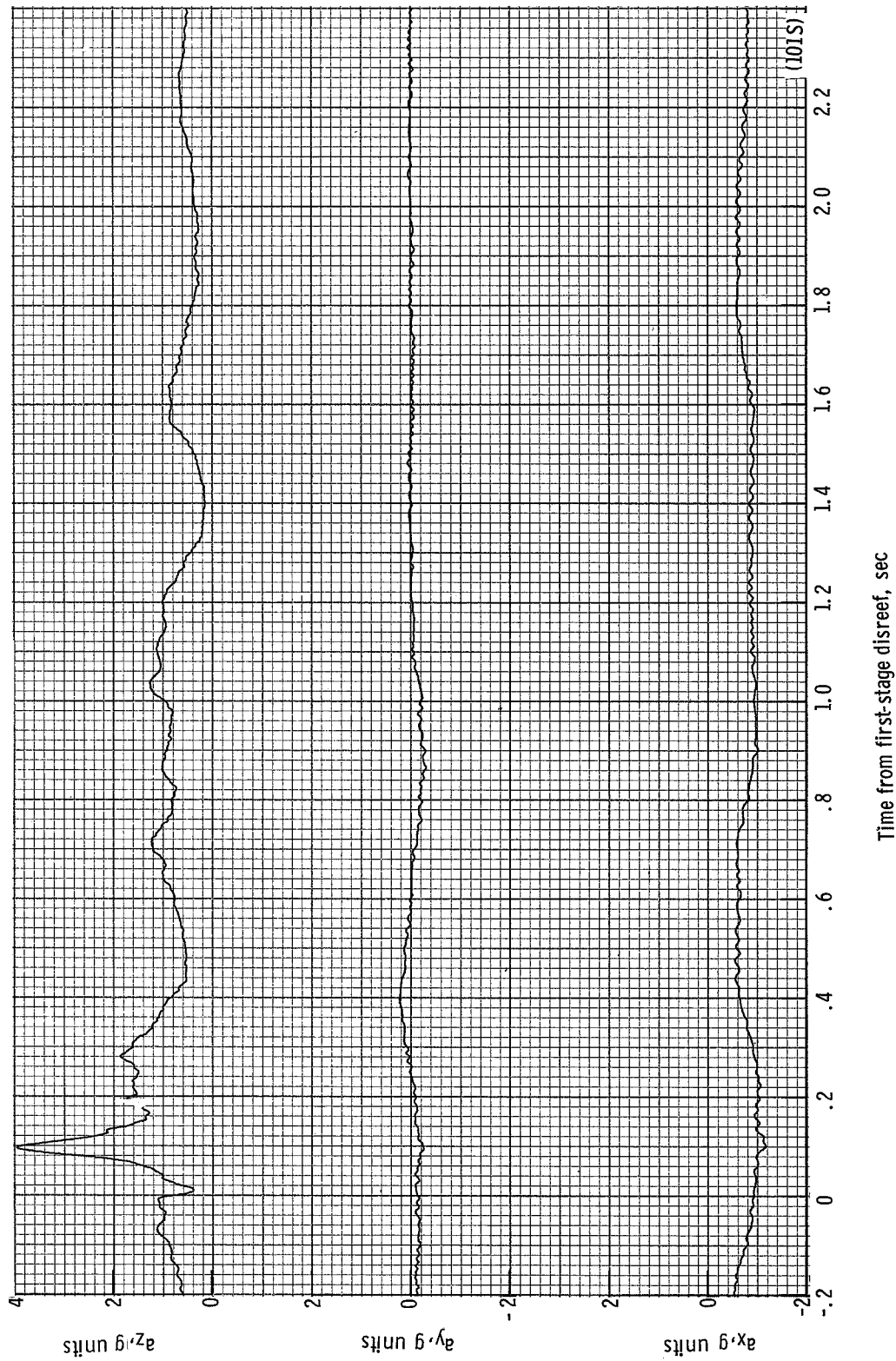
(f) Individual suspension-line loads F_{k12} , F_{te2} , F_{te3} , and F_{k1} plotted against time from first-stage disreef. Time = 0 second corresponds to 29.69 seconds after launch.

Figure 15.- Continued.



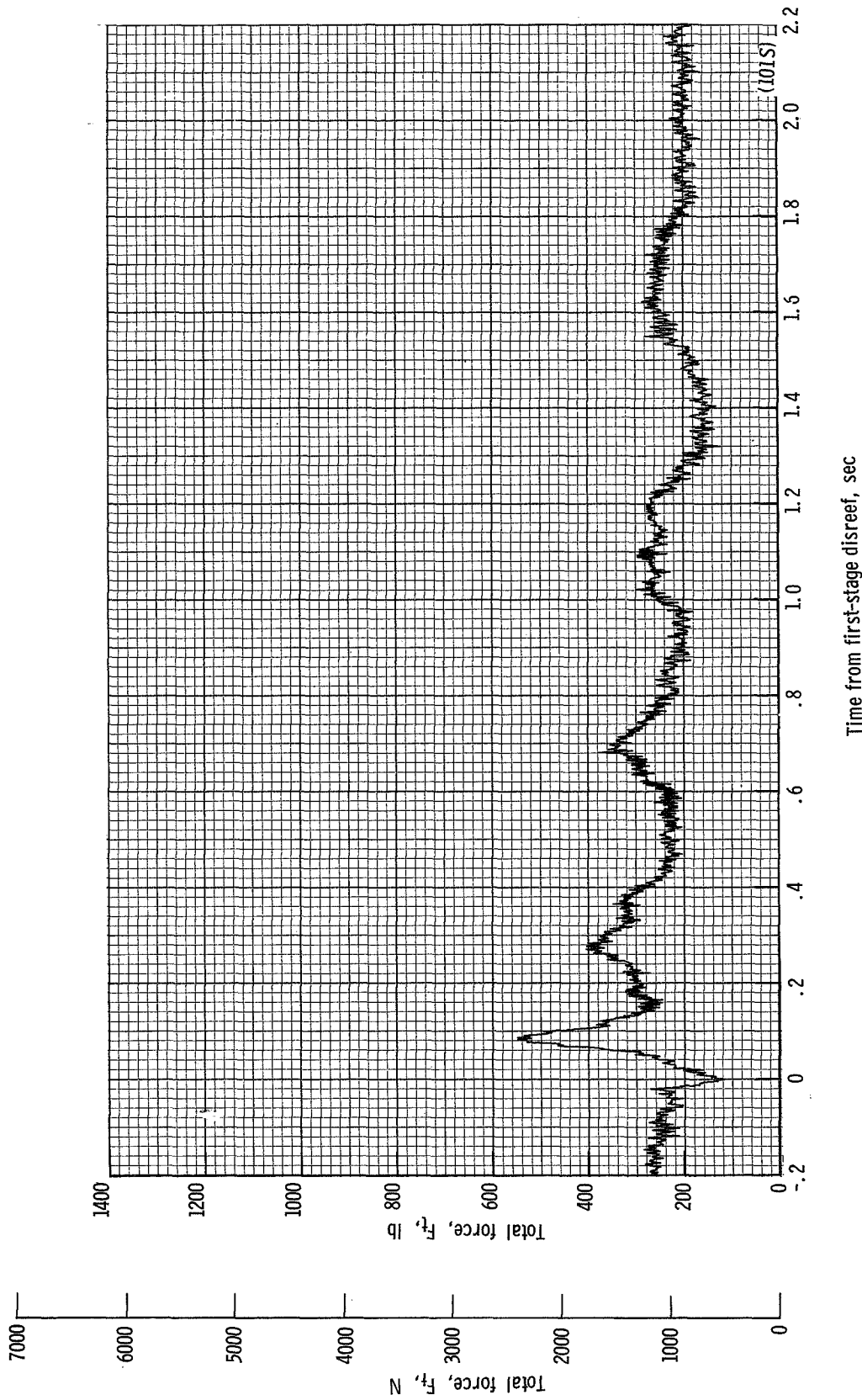
(g) Individual suspension-line loads F_{k7} , F_{Lle6} , and F_{Lle4} plotted against time from first-stage disreef. Time = 0 second corresponds to 29.69 seconds after launch.

Figure 15.- Continued.



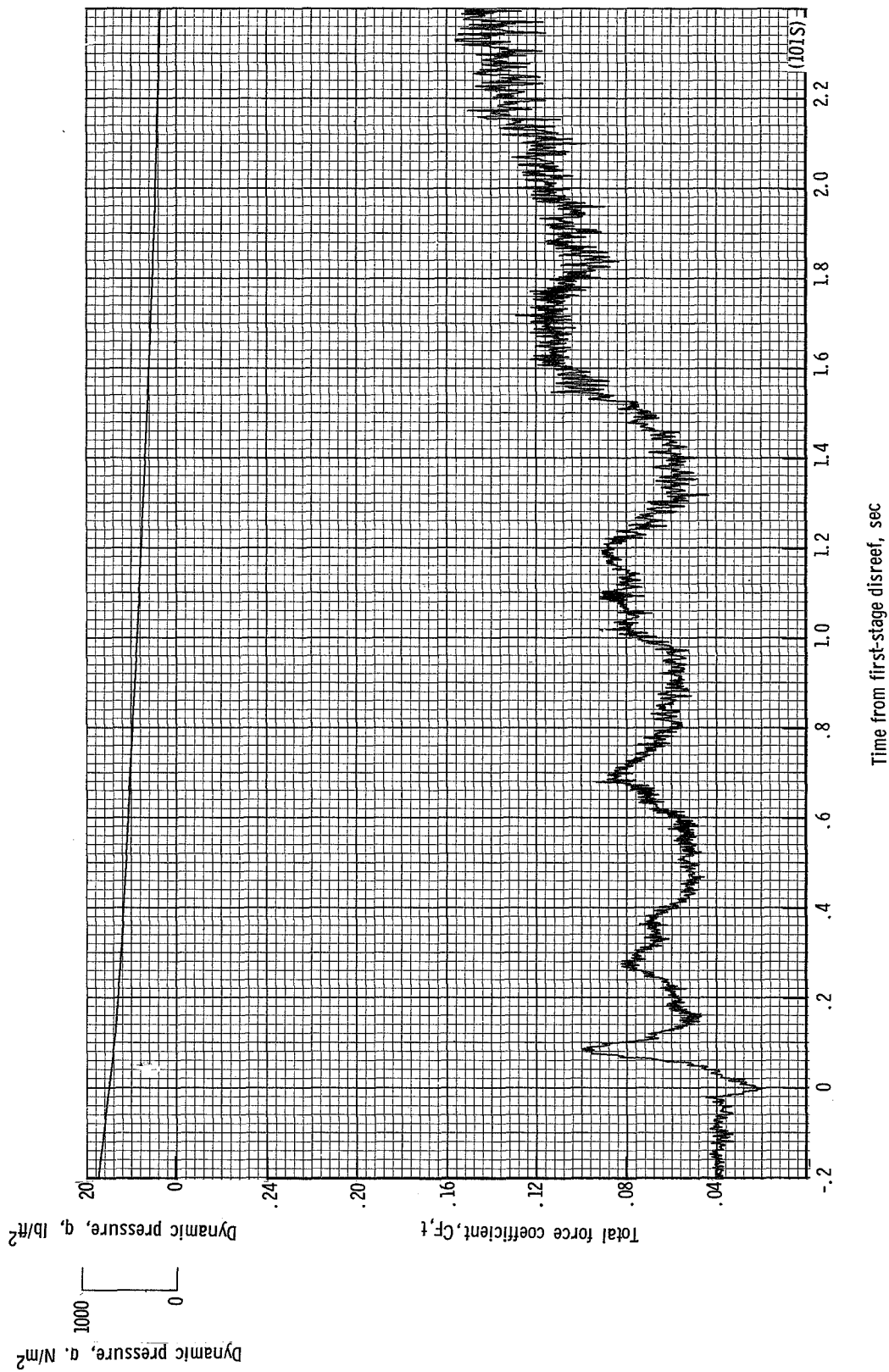
(h) Accelerations a_x , a_y , and a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 29.69 seconds after launch.

Figure 15.- Continued.



(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 29.69 seconds after launch.

Figure 15.- Continued.



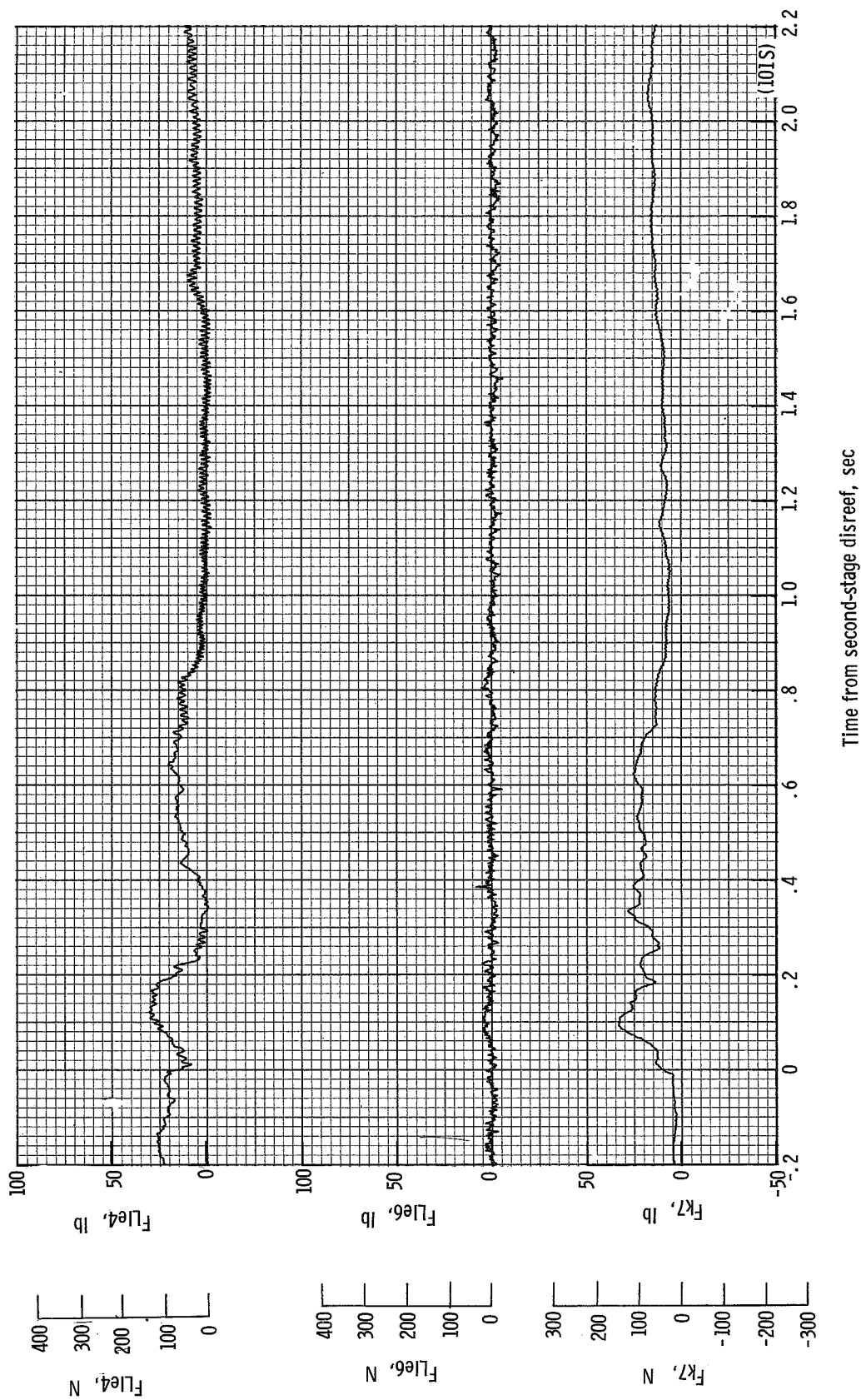
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 29.69 seconds after launch.

Figure 15.- Continued.

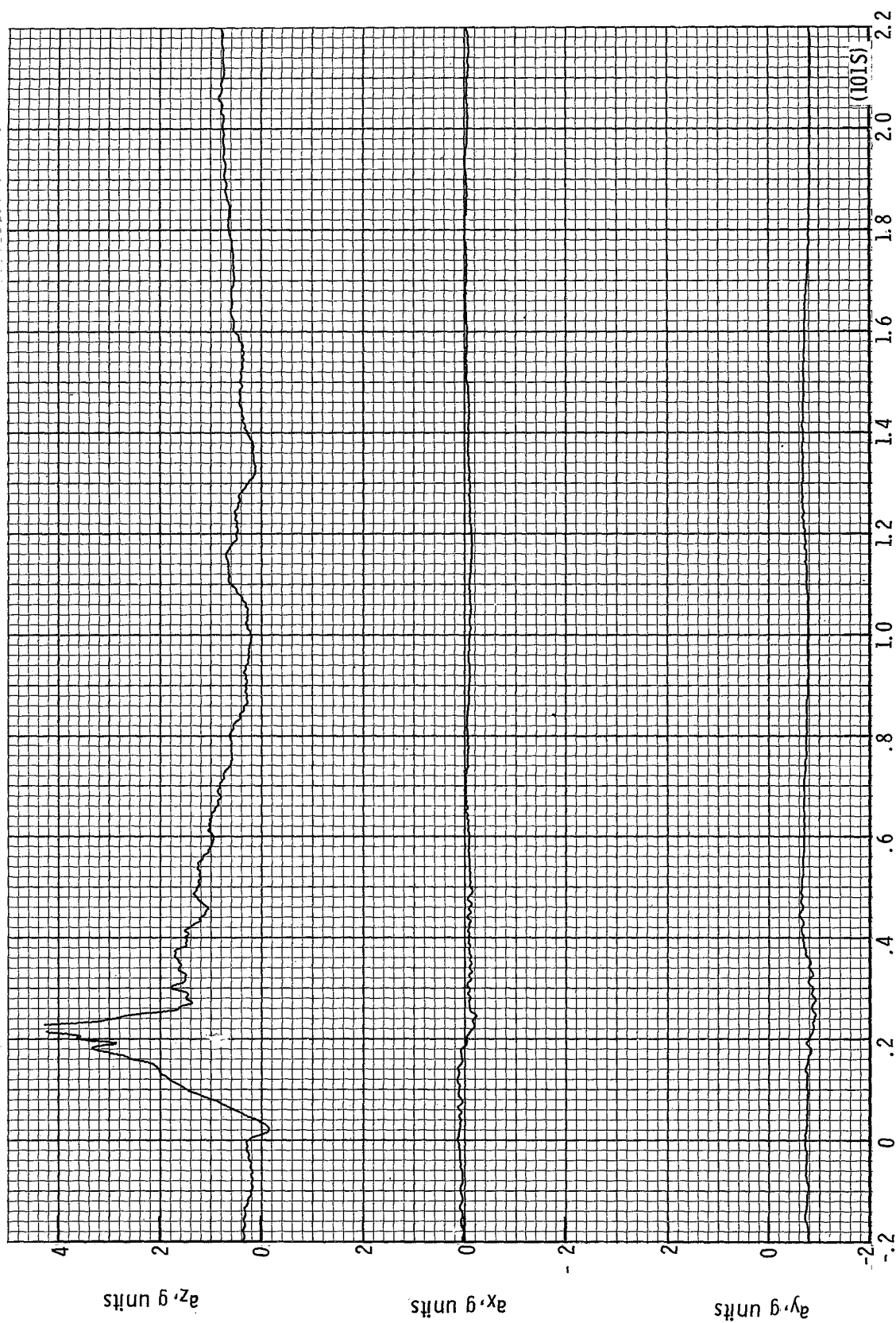


(k) Individual suspension-line loads F_{k12} , F_{Lie2} , F_{Lie3} , and F_{k1} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.57 seconds after launch.

Figure 15.- Continued.



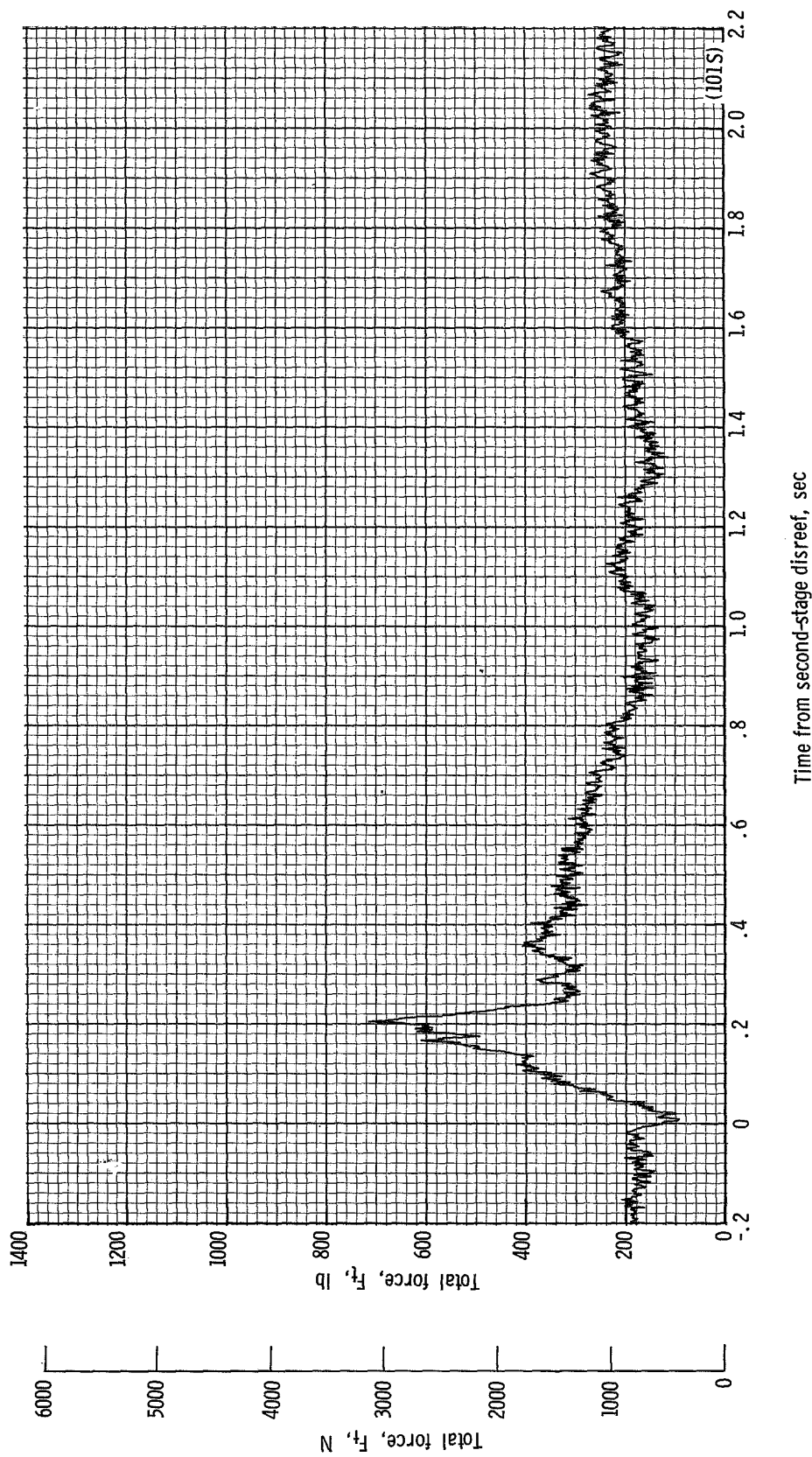
(1) Individual suspension-line loads F_{k7} , F_{Lle6} and F_{Lle4} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.57 seconds after launch.
Figure 15.- Continued.



Time from second-stage disreef, sec

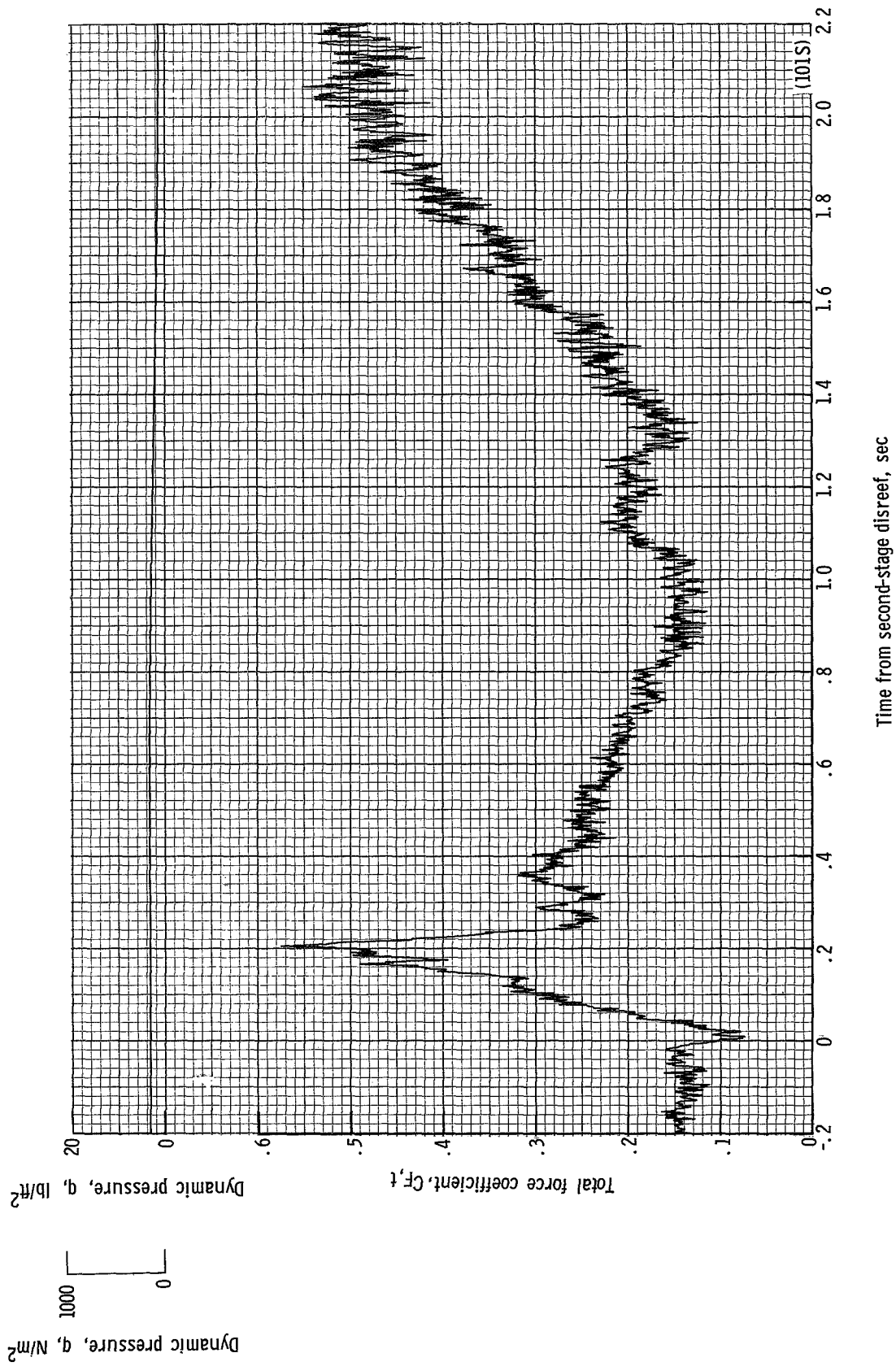
(m) Accelerations a_x , a_y , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 32.57 seconds after launch.

Figure 15.- Continued.



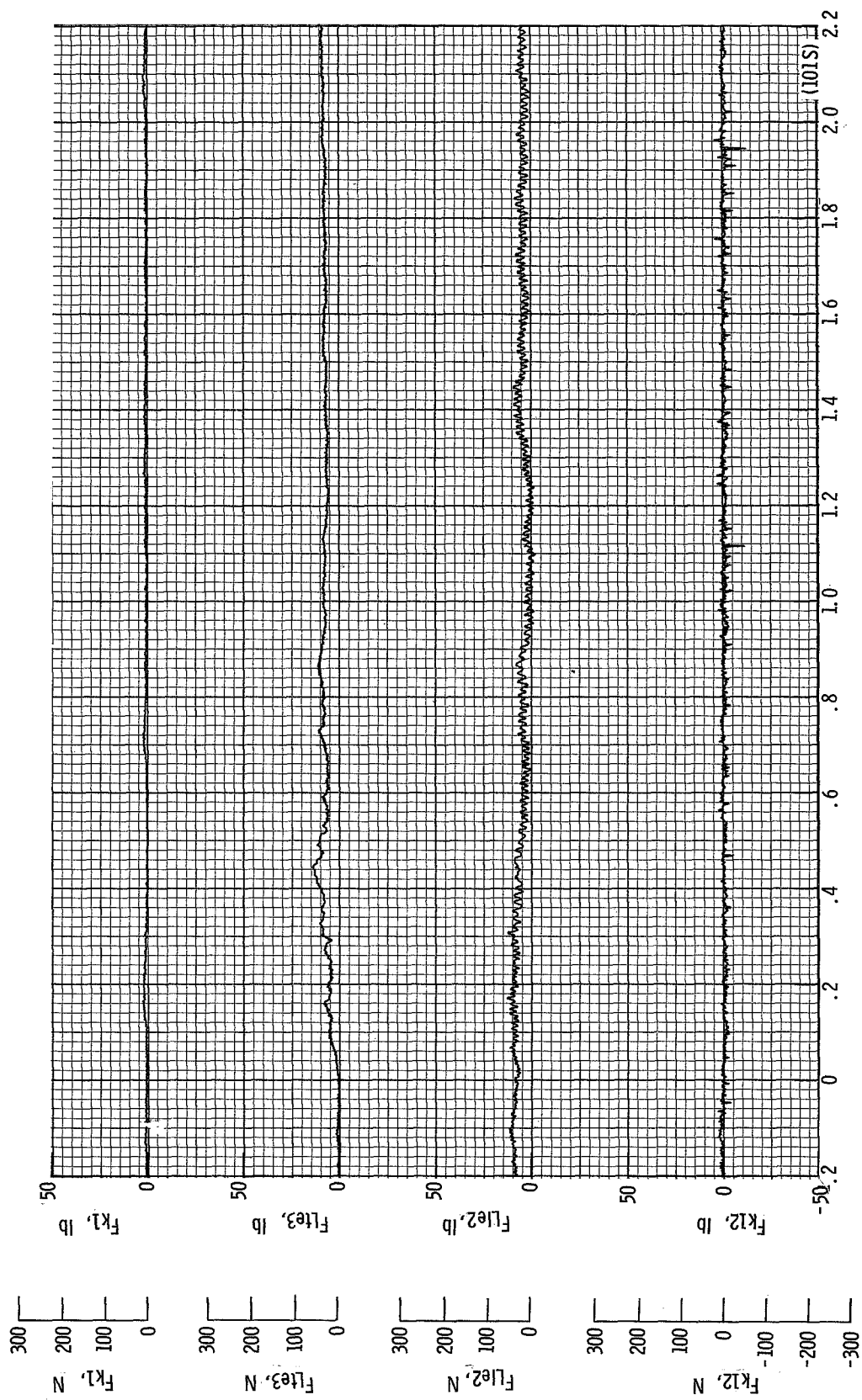
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 32.57 seconds after launch.

Figure 15.- Continued.



(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 32.57 seconds after launch.

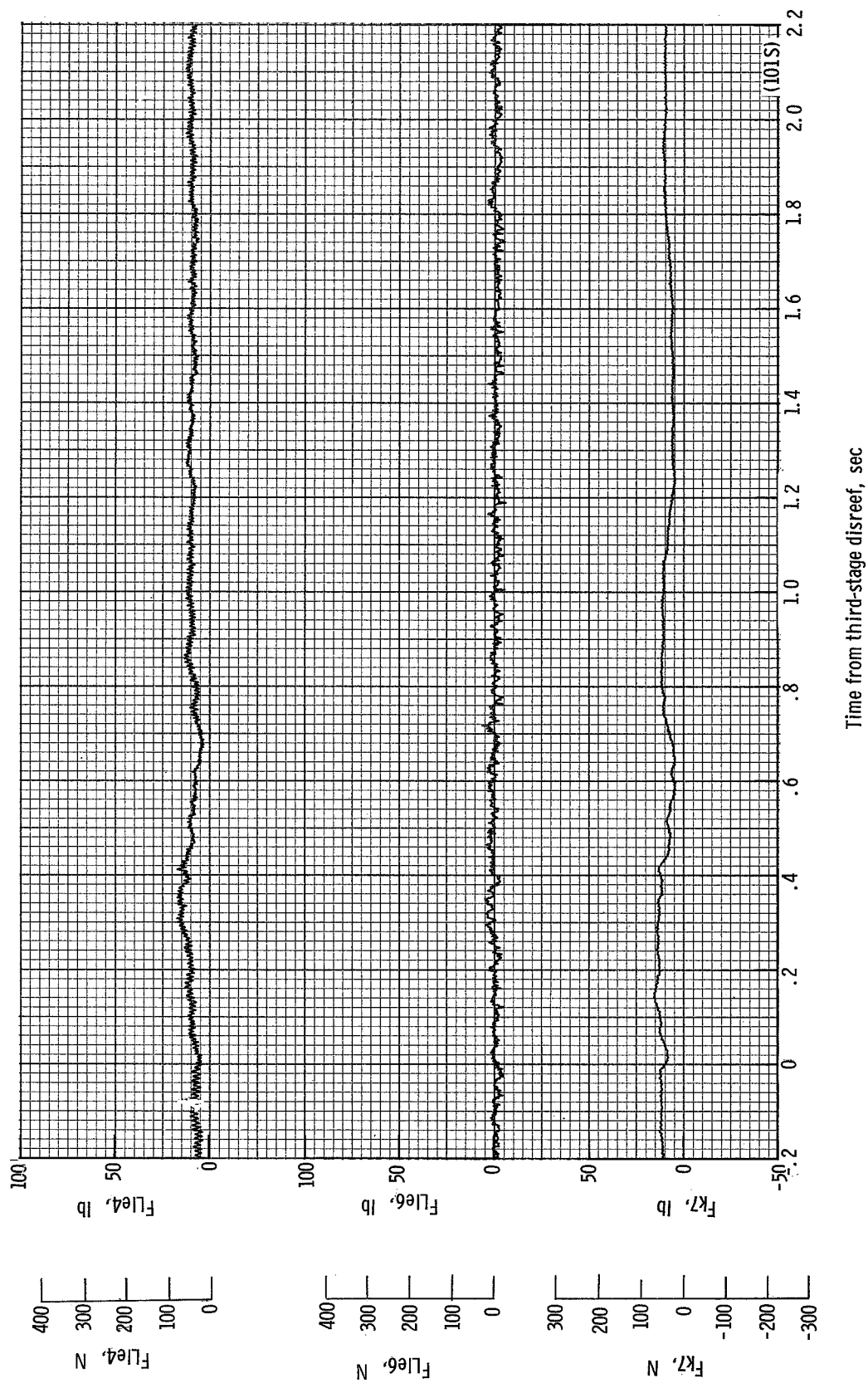
Figure 15: - Continued.



Time from third-stage disreef, sec

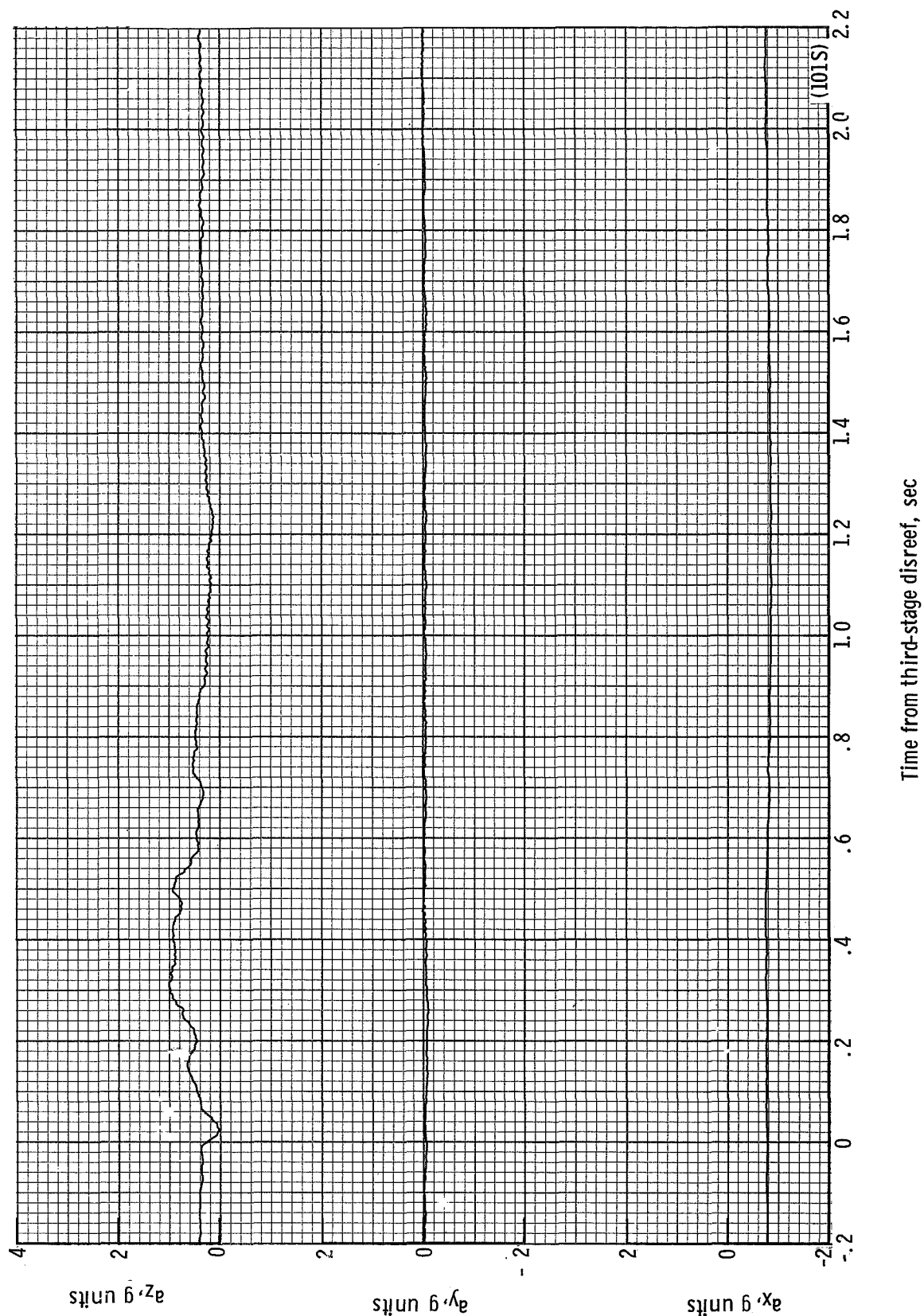
(p) Individual suspension-line loads F_{k12} , F_{k1} , F_{Le2} , and F_{Le3} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.26 seconds after launch.

Figure 15.- Continued.



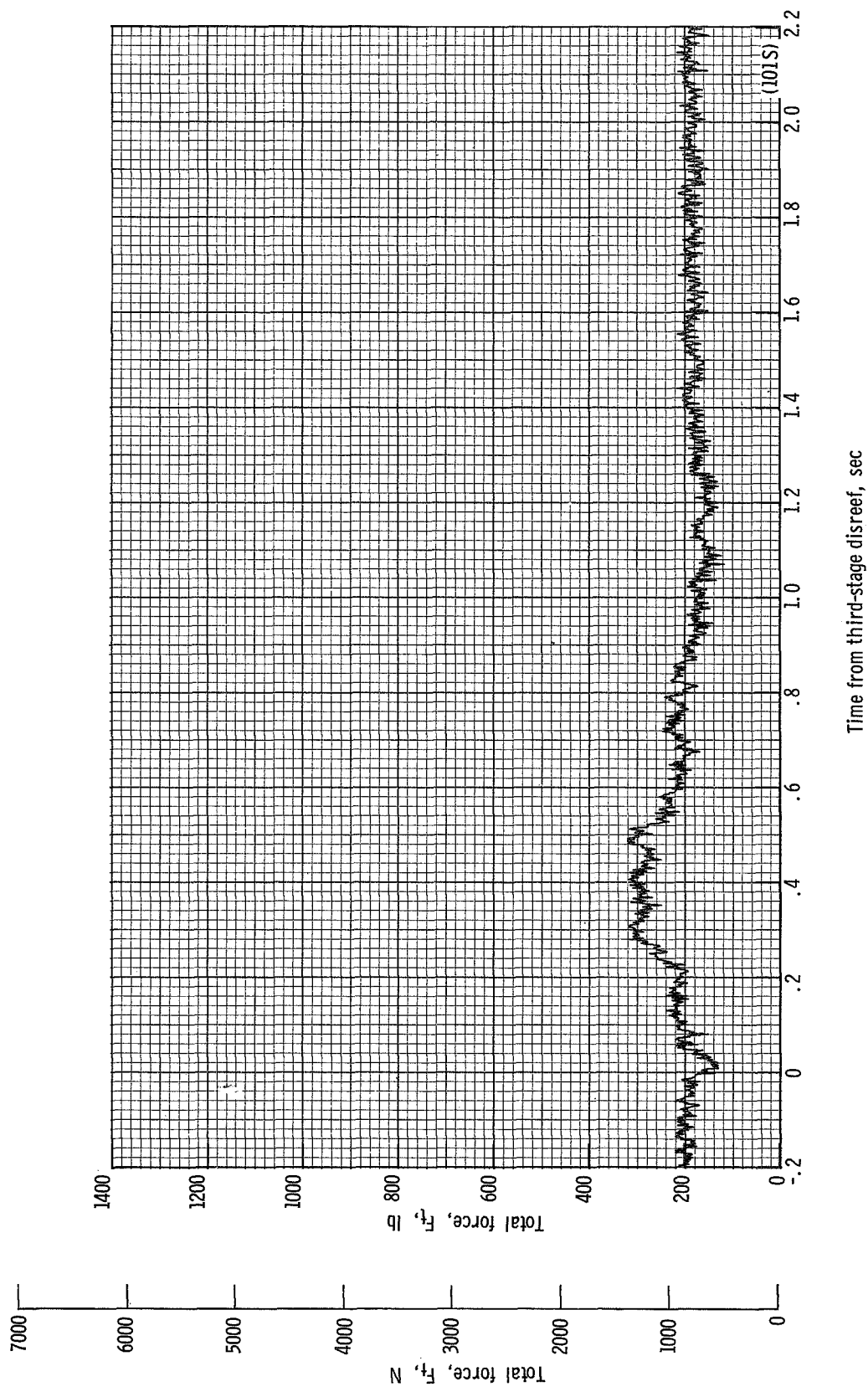
(q) Individual suspension-line loads F_{k7} , $F_{L_{ie6}}$ and $F_{L_{ie4}}$ plotted against time from third-stage disreef. Time = 0 second corresponds to 36.26 seconds after launch.

Figure 15.- Continued.



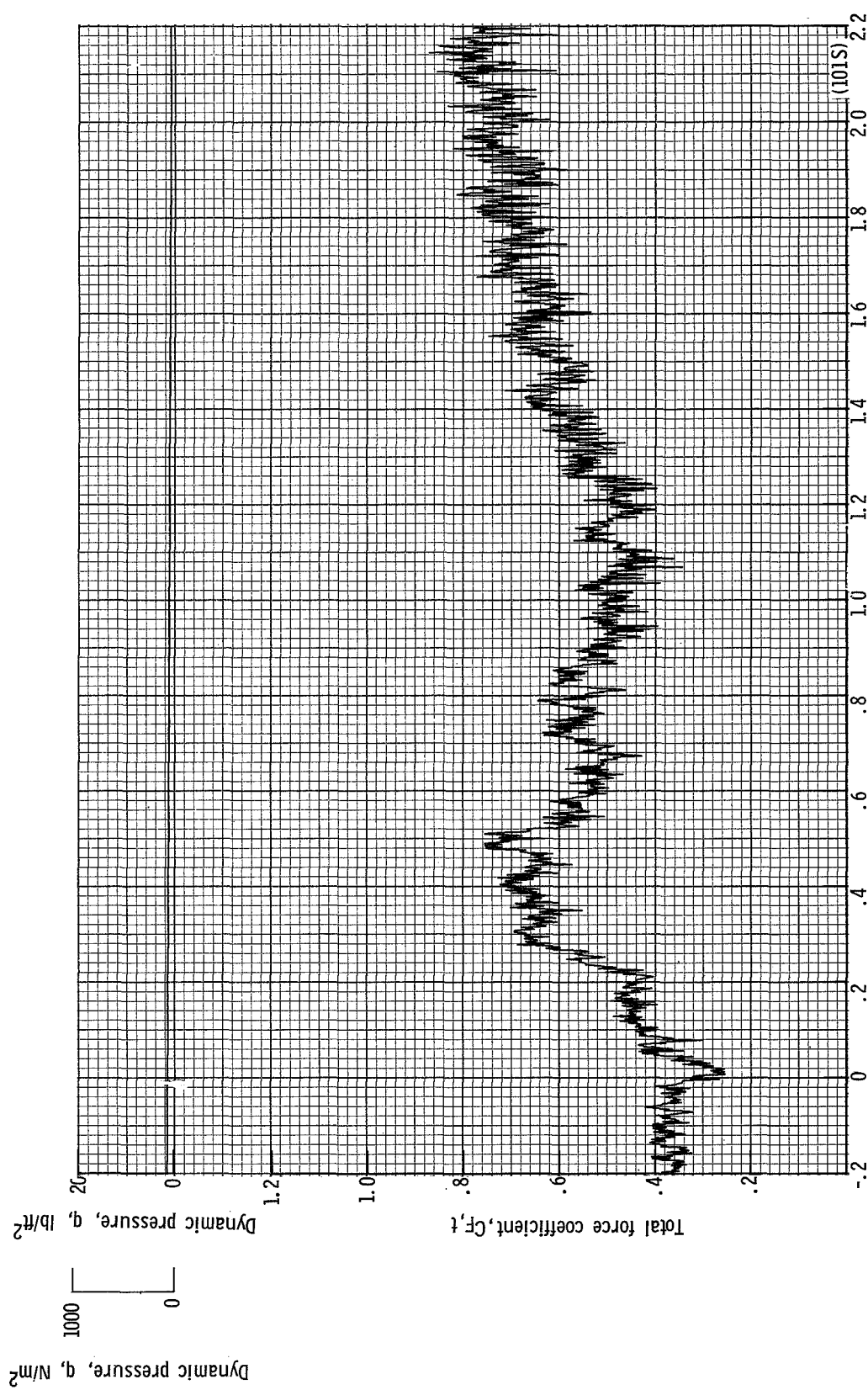
(r) Accelerations a_x , a_y , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 36.26 seconds after launch.

Figure 15.- Continued.



(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.26 seconds after launch.

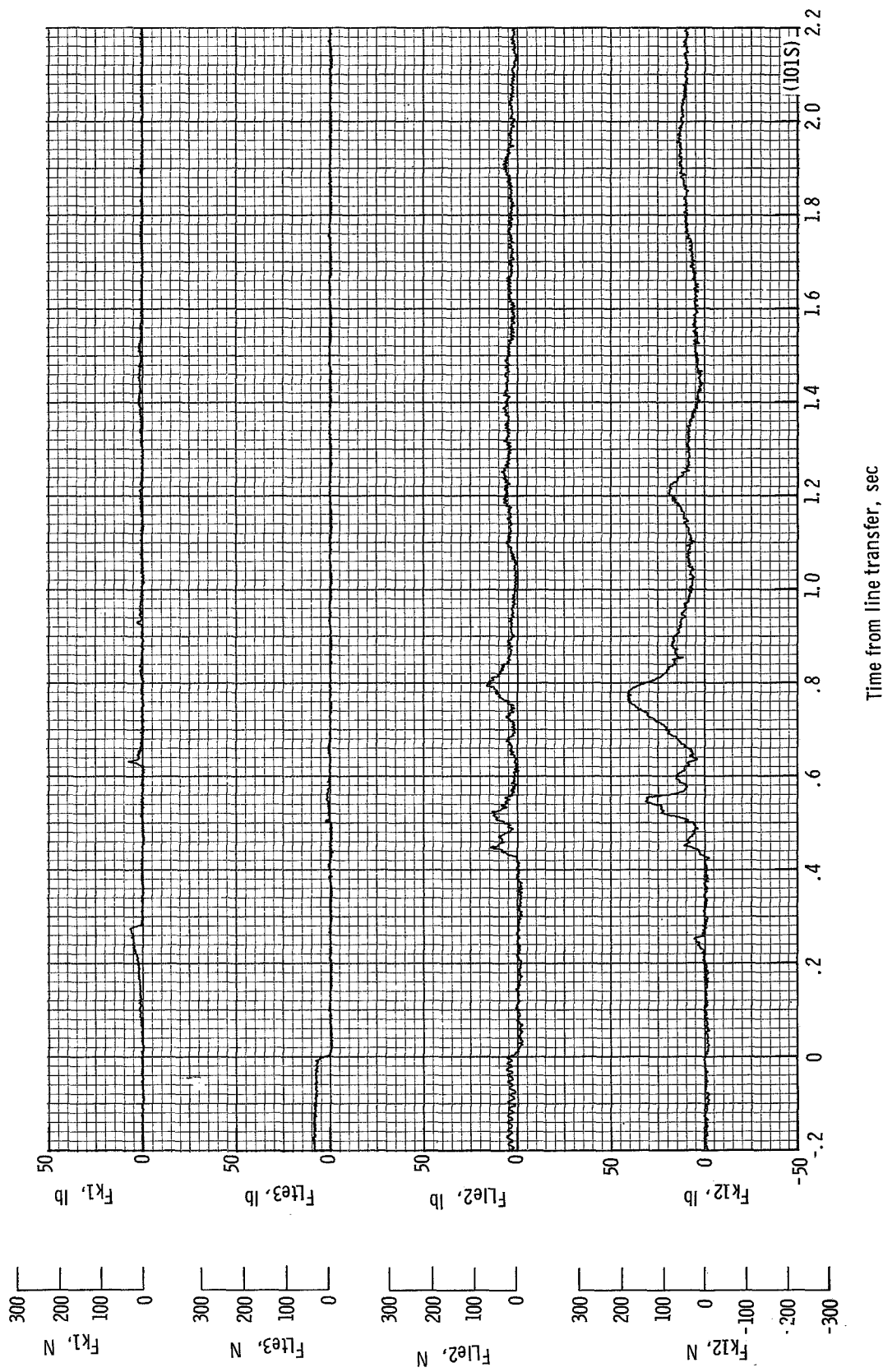
Figure 15.- Continued.



Time from third-stage disreef, sec

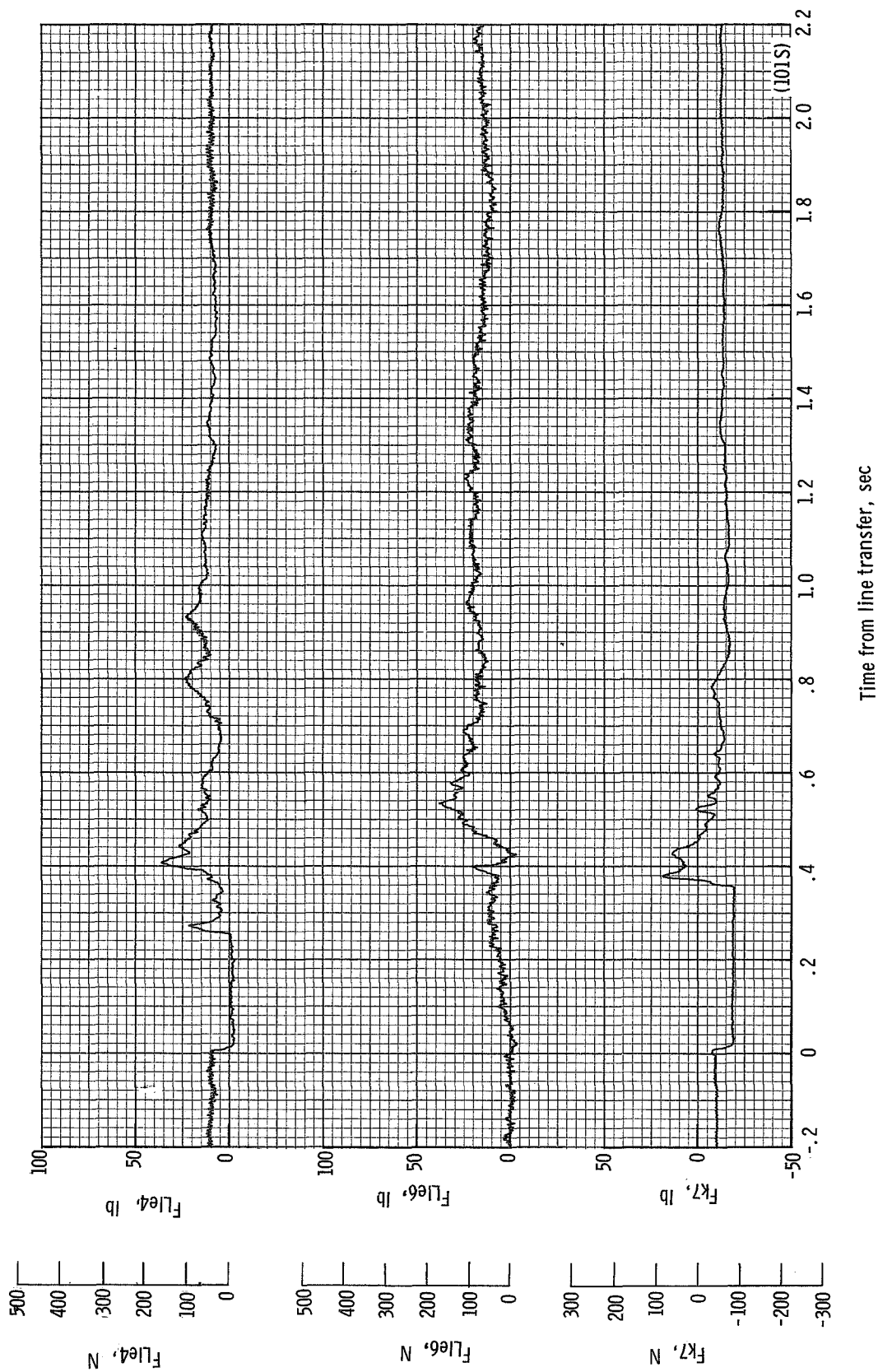
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.26 seconds after launch.

Figure 15.- Continued.



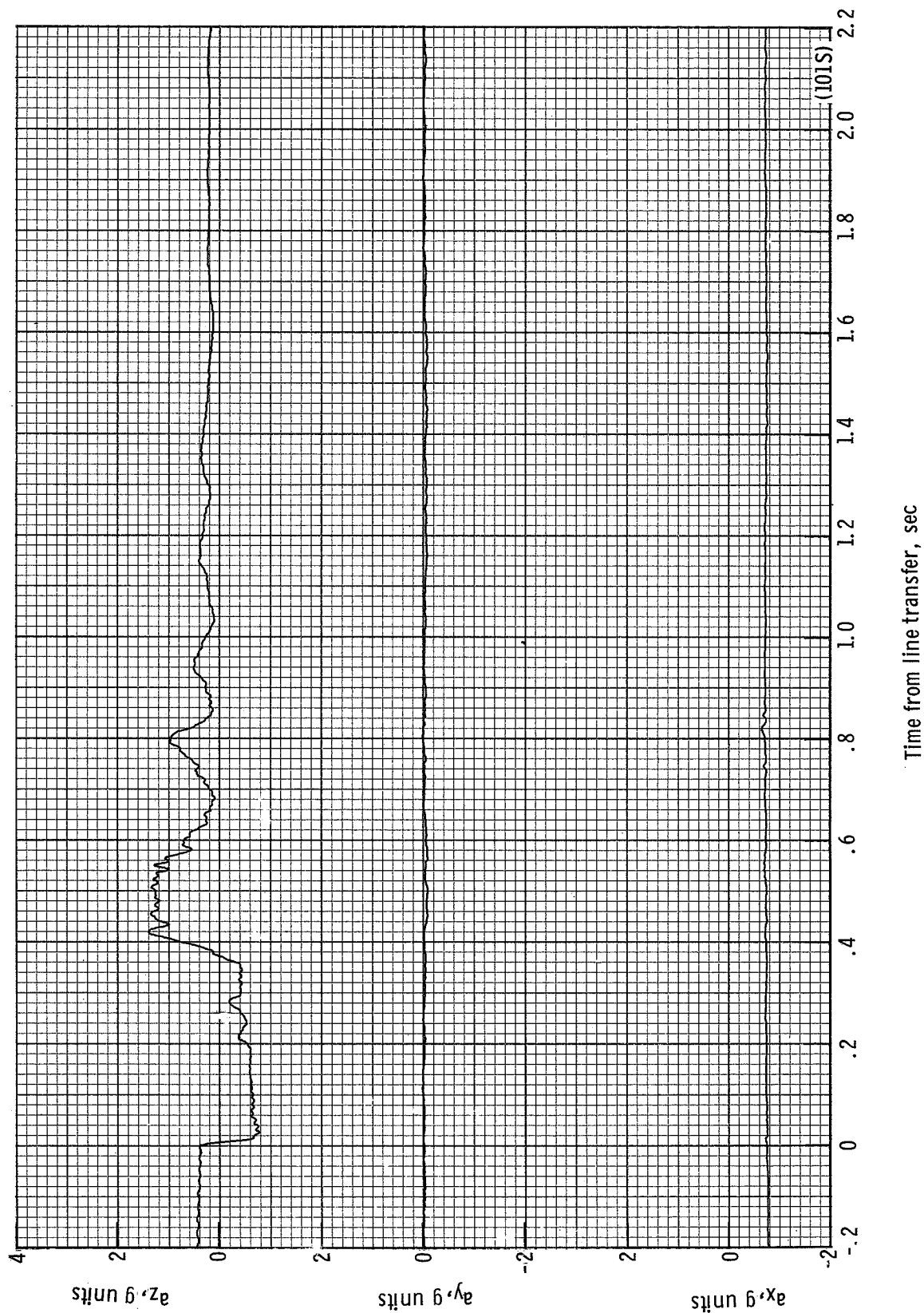
(u) Individual suspension-line loads F_{k12} , F_{k1e2} , F_{k1e3} , and F_{k1} plotted against time from line transfer. Time = 0 second corresponds to 38.94 seconds after launch.

Figure 15.- Continued.



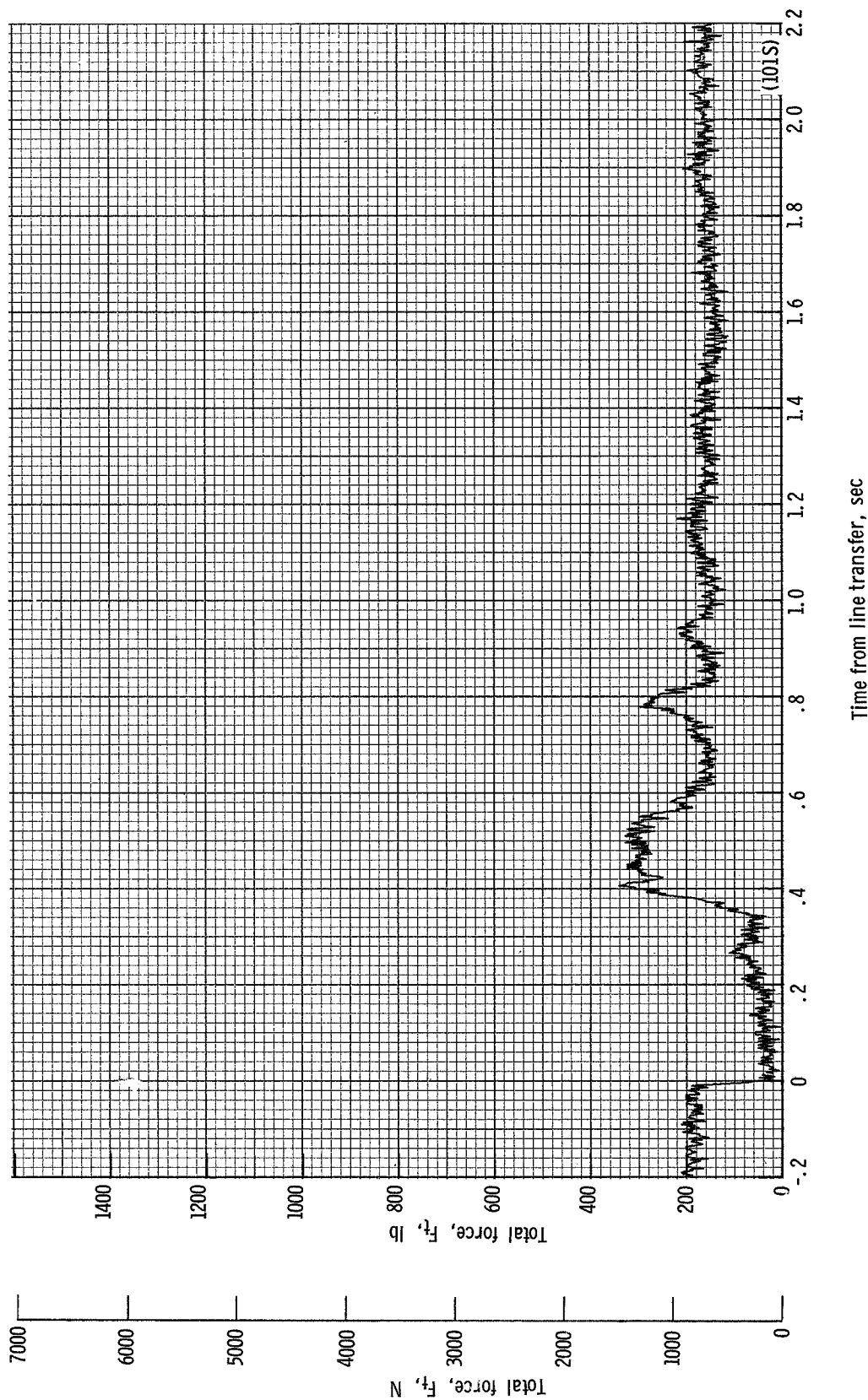
(v) Individual suspension-line loads F_{k7} , F_{Lle6} and F_{Lle4} plotted against time from line transfer. Time = 0 second corresponds to 38.94 seconds after launch.

Figure 15.- Continued.



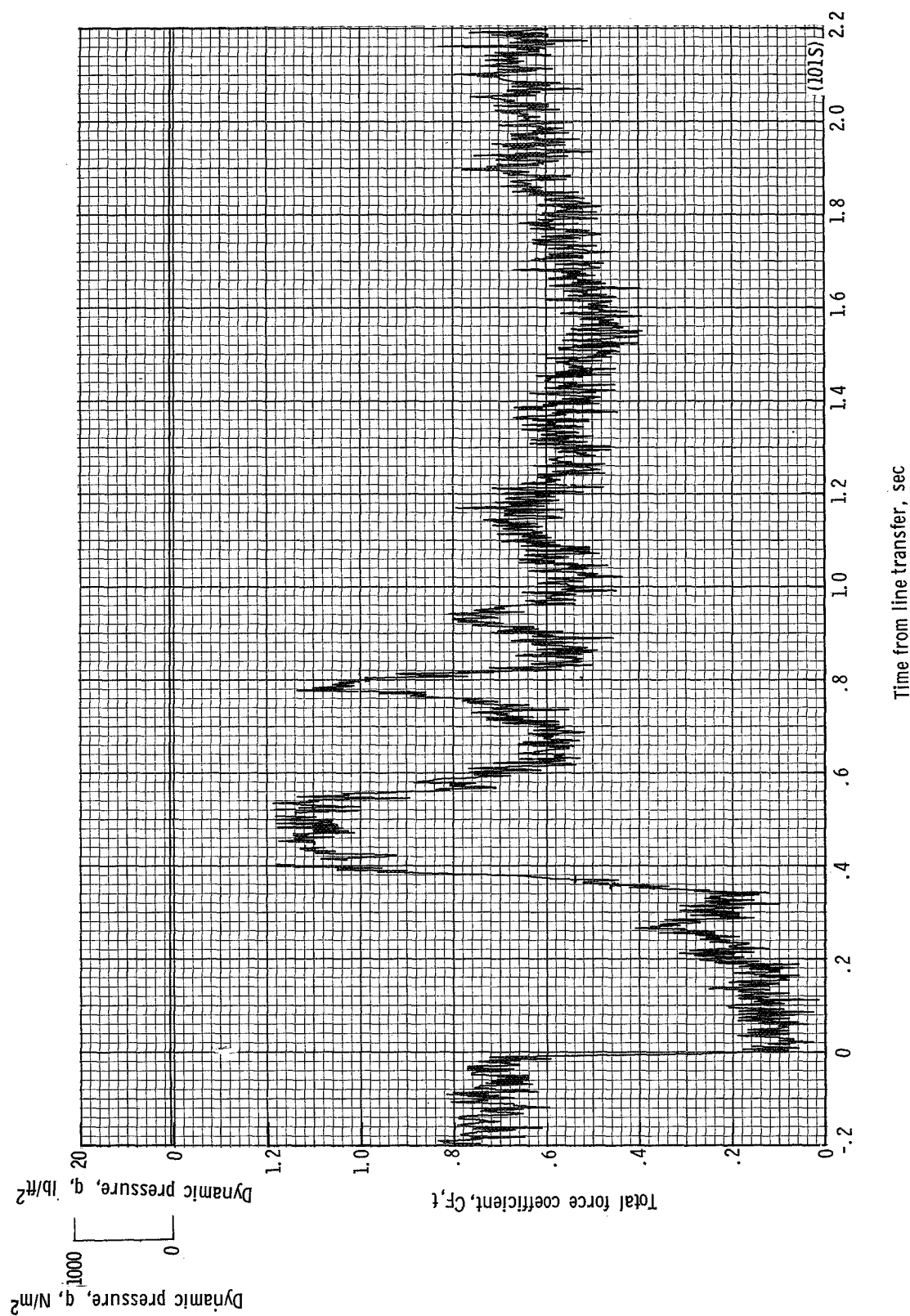
(w) Accelerations a_x , a_y , and a_z plotted against time from line transfer. Time = 0 second corresponds to 38.94 seconds after launch.

Figure 15.- Continued.



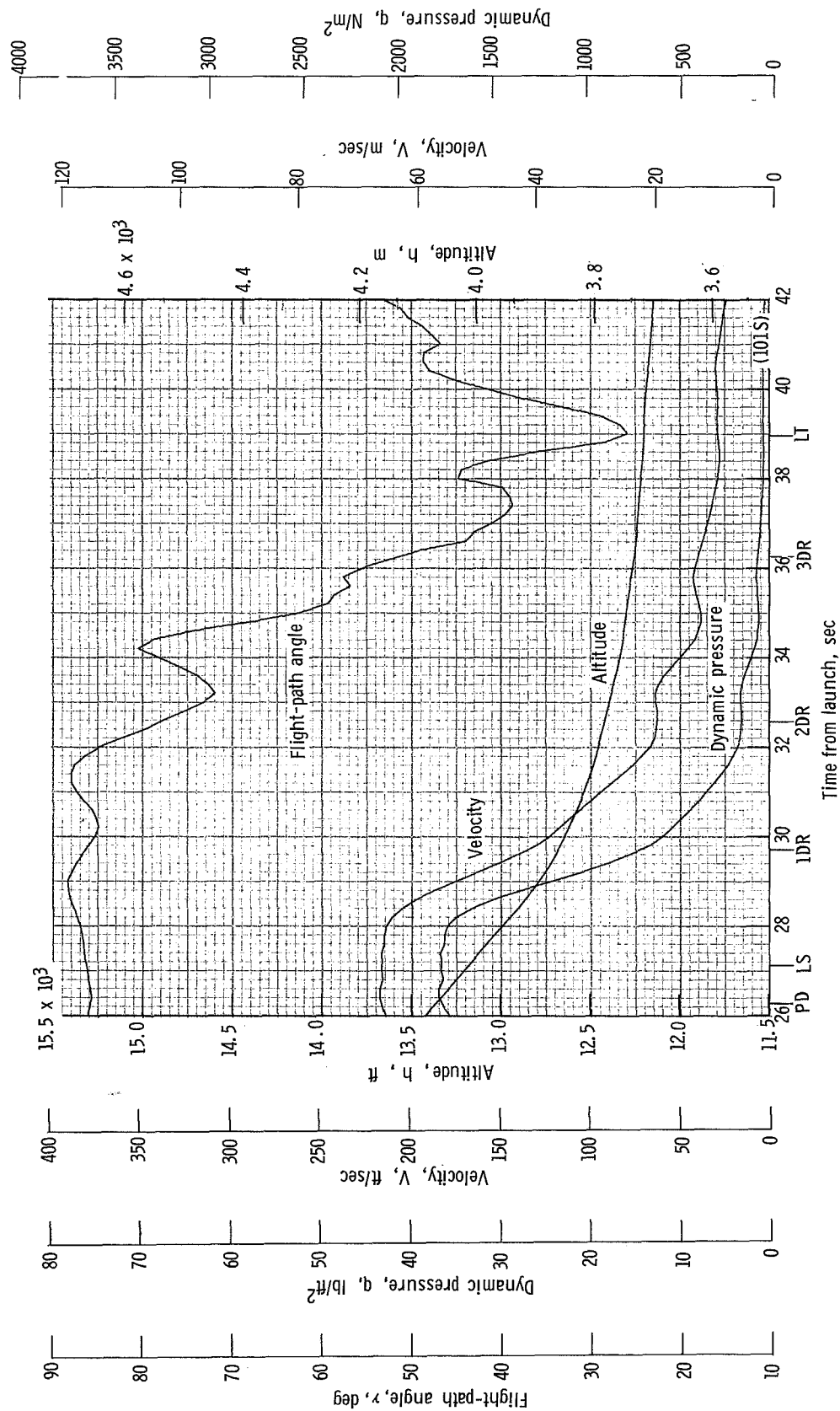
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 38.94 seconds after launch.

Figure 15.- Continued.



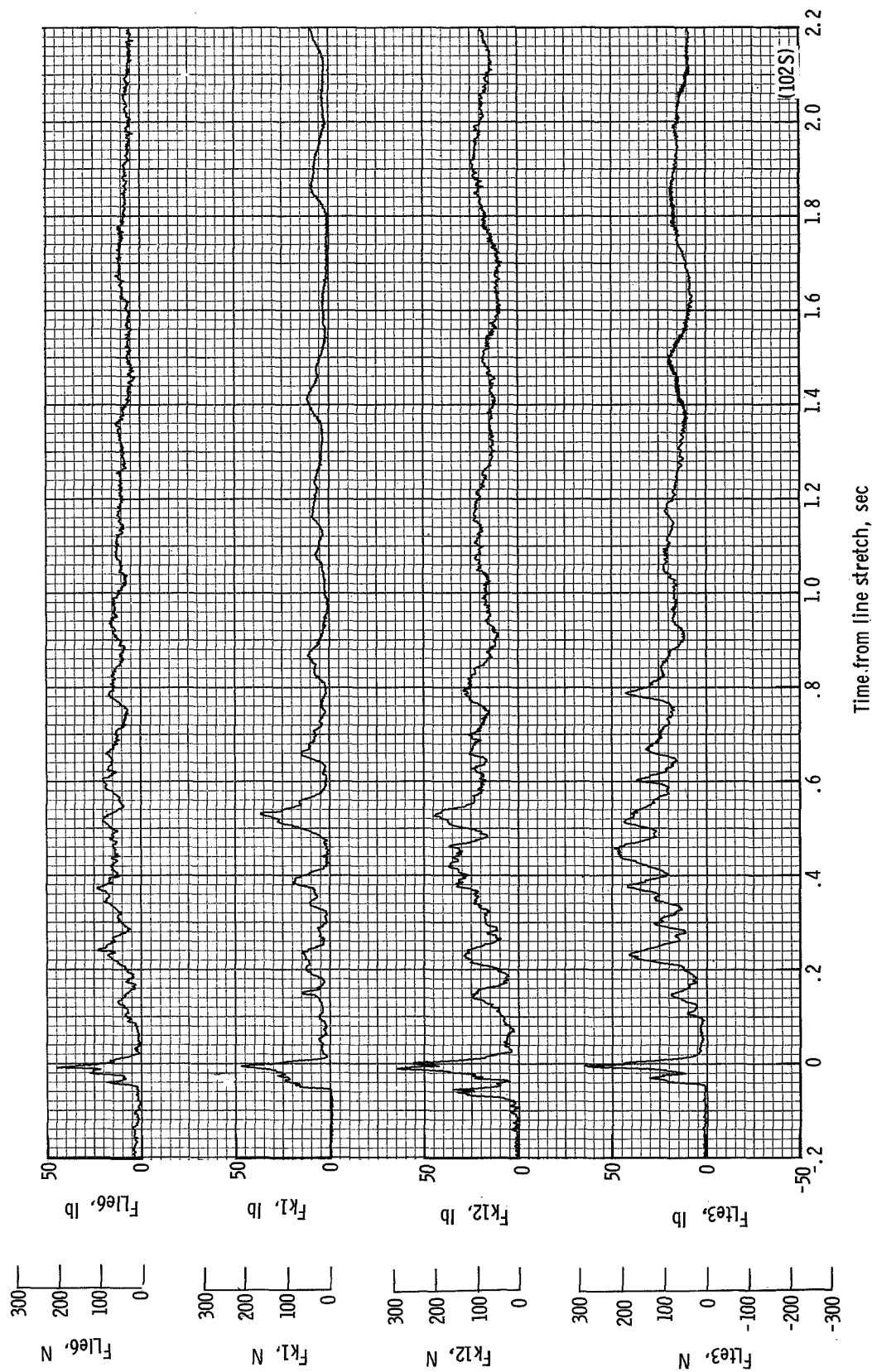
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 38.94 seconds after launch.

Figure 15.- Continued.



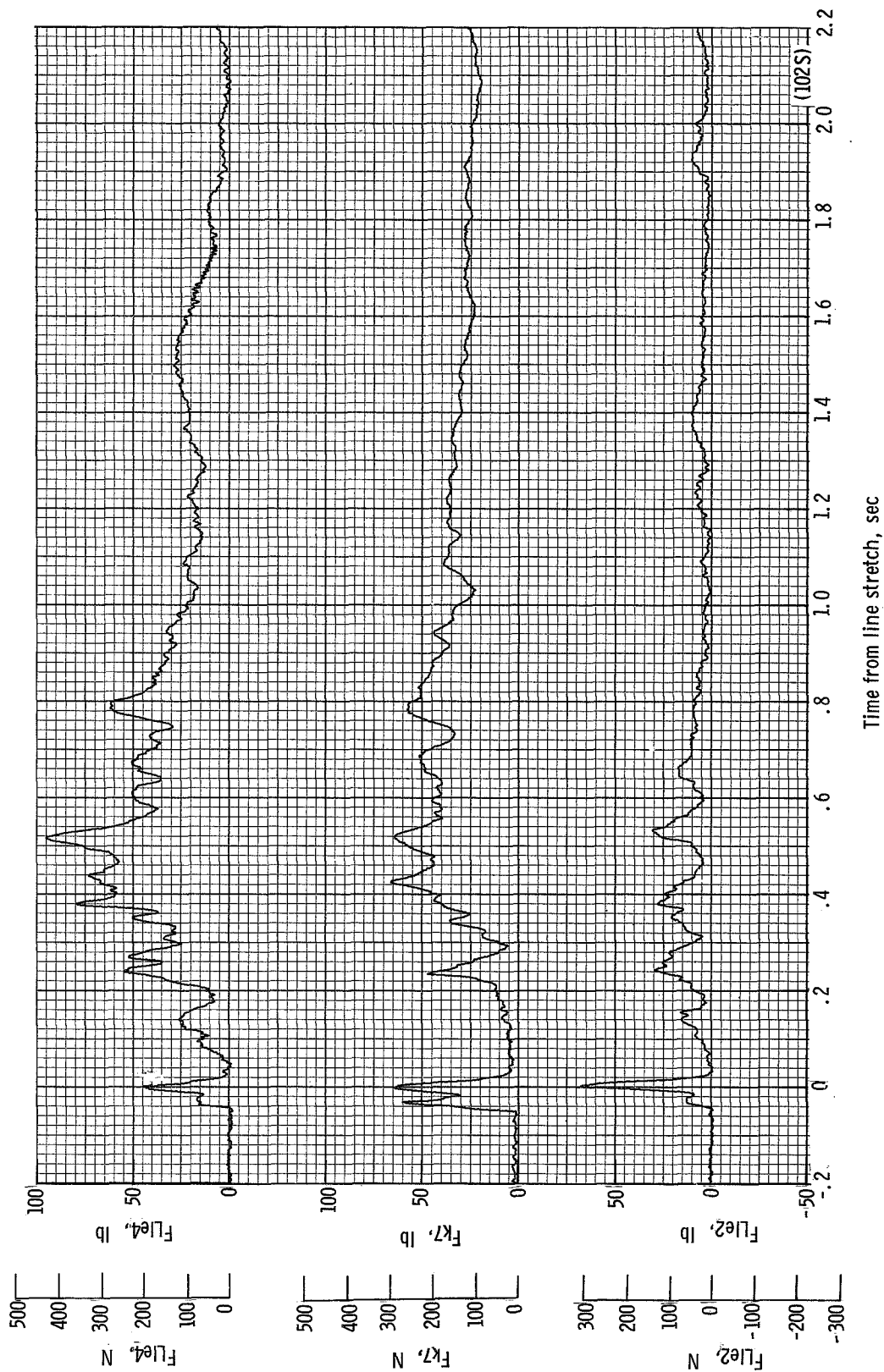
(z) Flight-path angle γ , dynamic pressure q , and velocity V , and altitude h plotted against time from launch.

Figure 15.- Concluded.



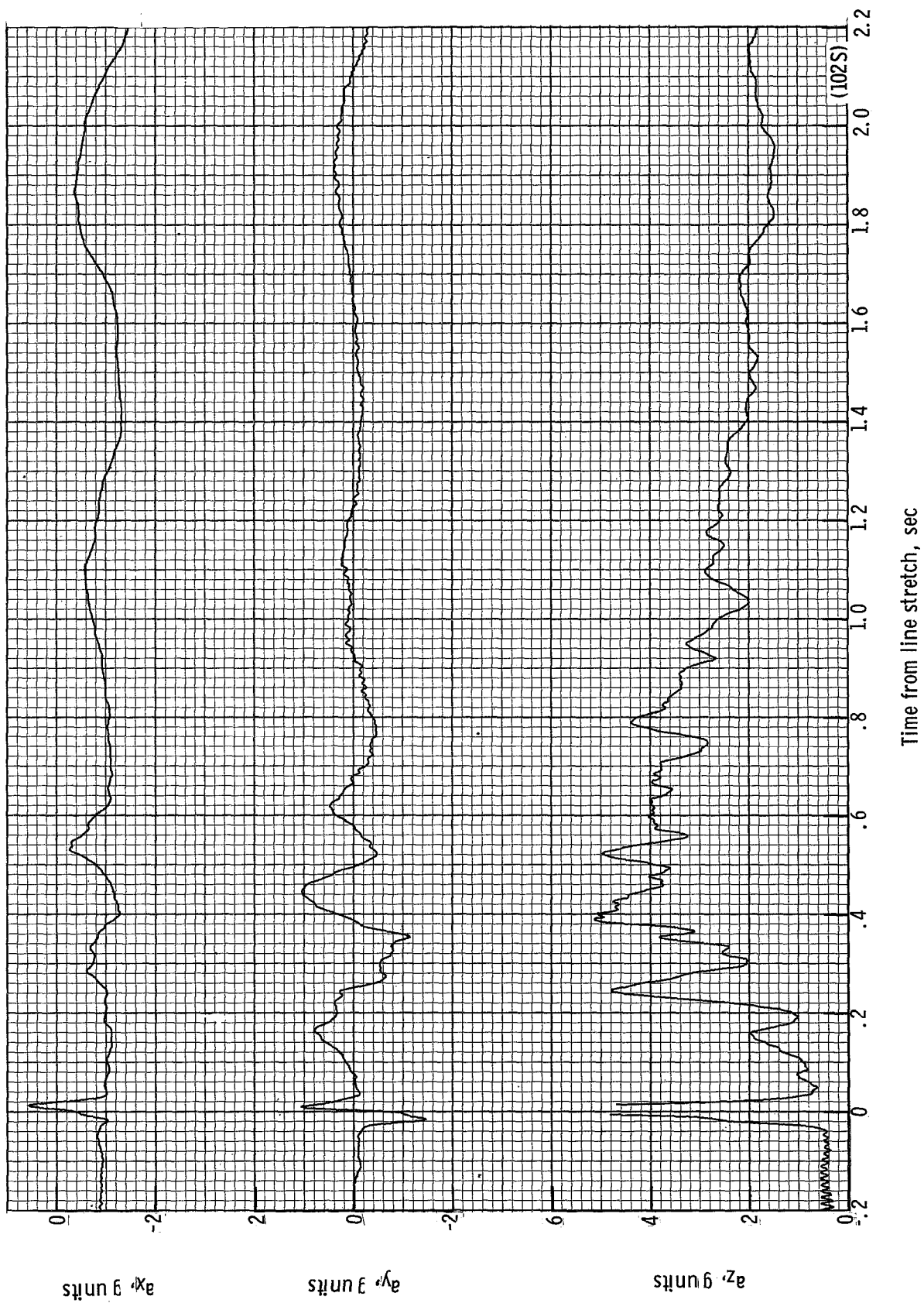
(a) Individual suspension-line loads F_{Lte3} , F_{k12} , F_{k1} , and F_{Lte6} plotted against time from line stretch. Time = 0 second corresponds to 28.09 seconds after launch.

Figure 16.- Time history of single-keel parawing deployment data for test 102S. $W_D = 1144.1$ N (257.2 lb); $W_P = 1007.5$ N (226.5 lb); $q_{PD} = 1584.8$ N/m² (33.1 lb); $h_{PD} = 1004$ m (3294 ft); $t_r/L_k = 0.156$; reefing version 11.



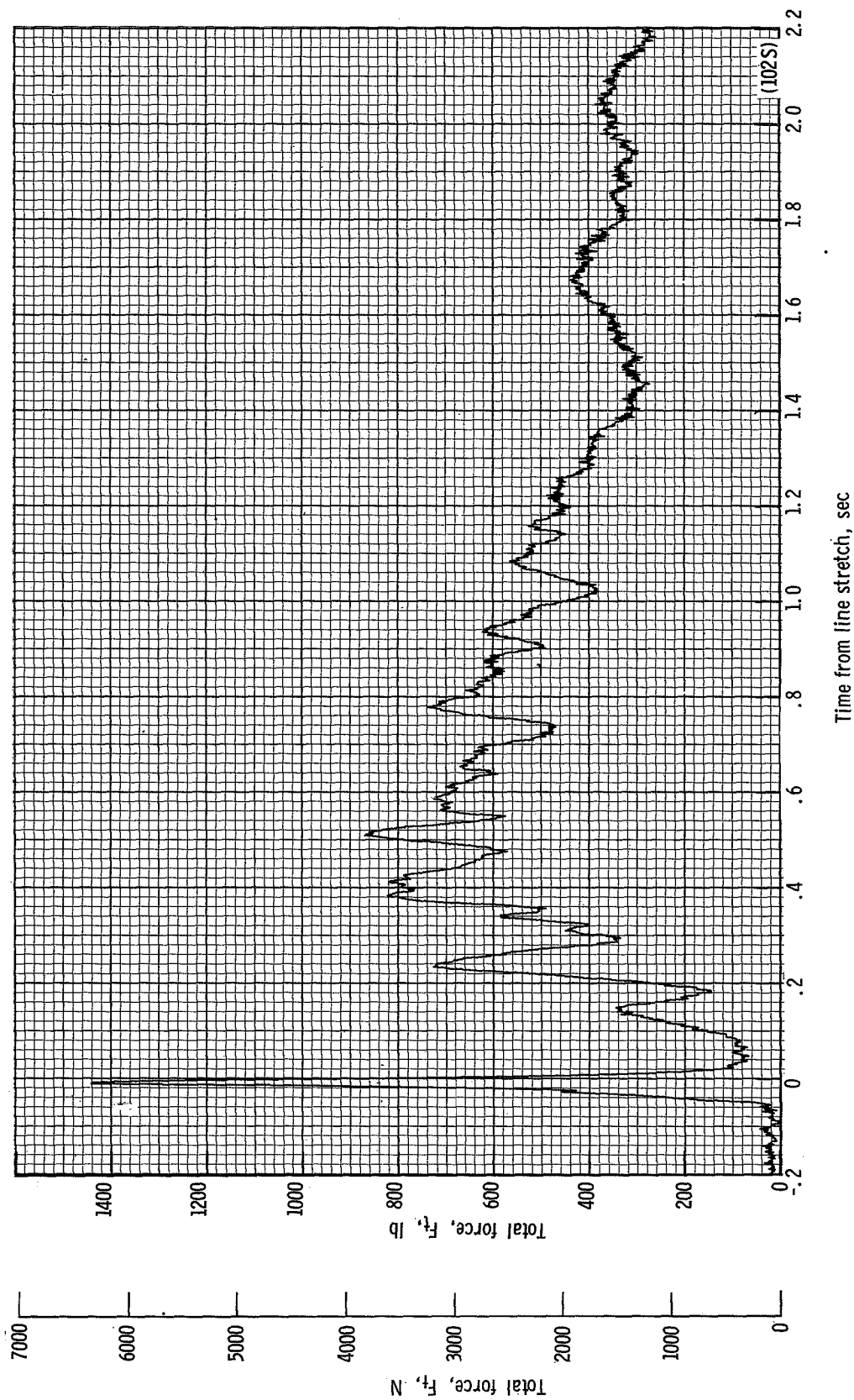
(b) Individual suspension-line loads F_{Lle2} , F_{k7} , and F_{Lle4} plotted against time from line stretch. Time = 0 second corresponds to 28.09 seconds after launch.

Figure 16.- Continued.



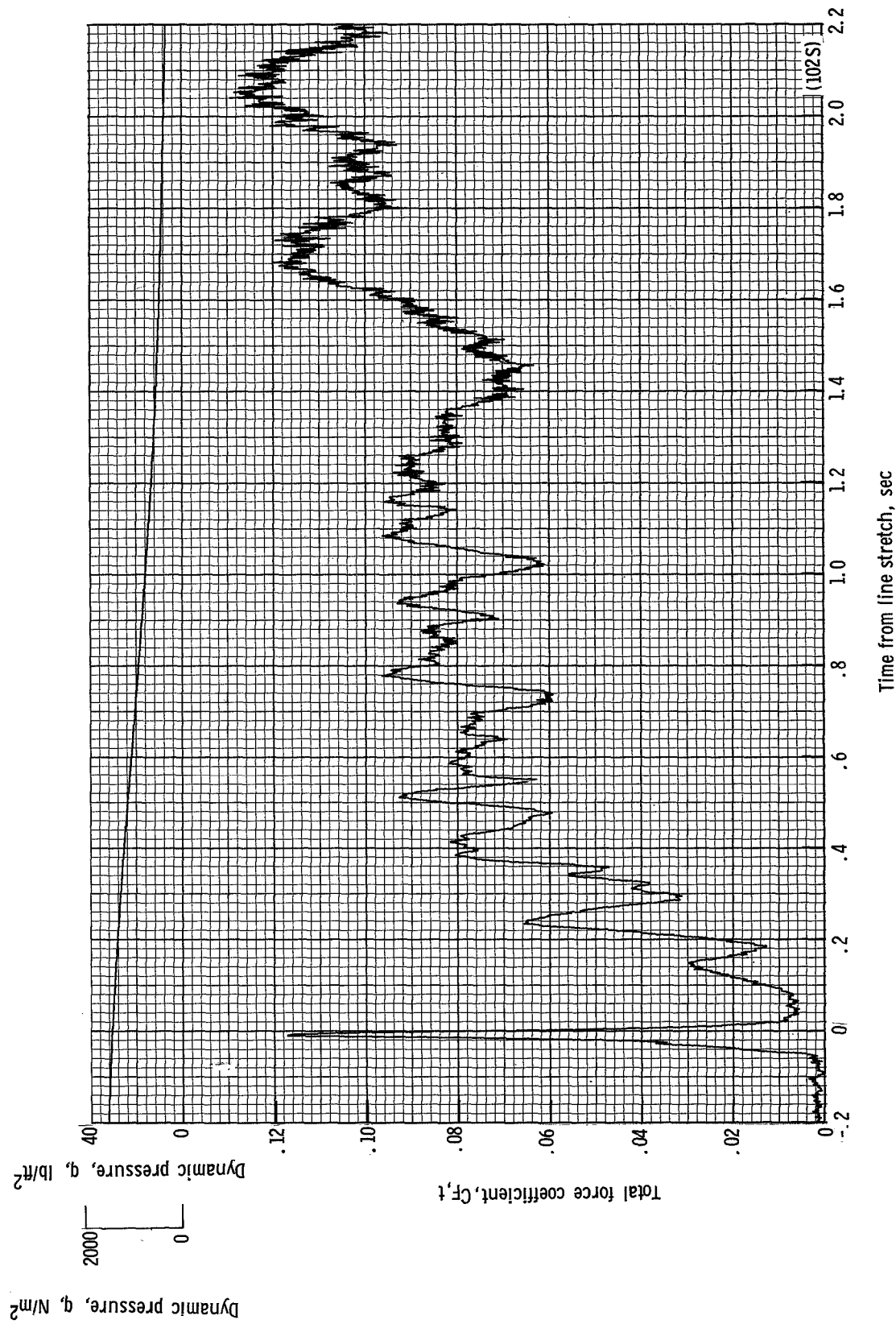
(c) Accelerations a_x , a_y , and a_z plotted against time from line stretch. Time = 0 second corresponds to 28.09 seconds after launch.

Figure 16.- Continued.



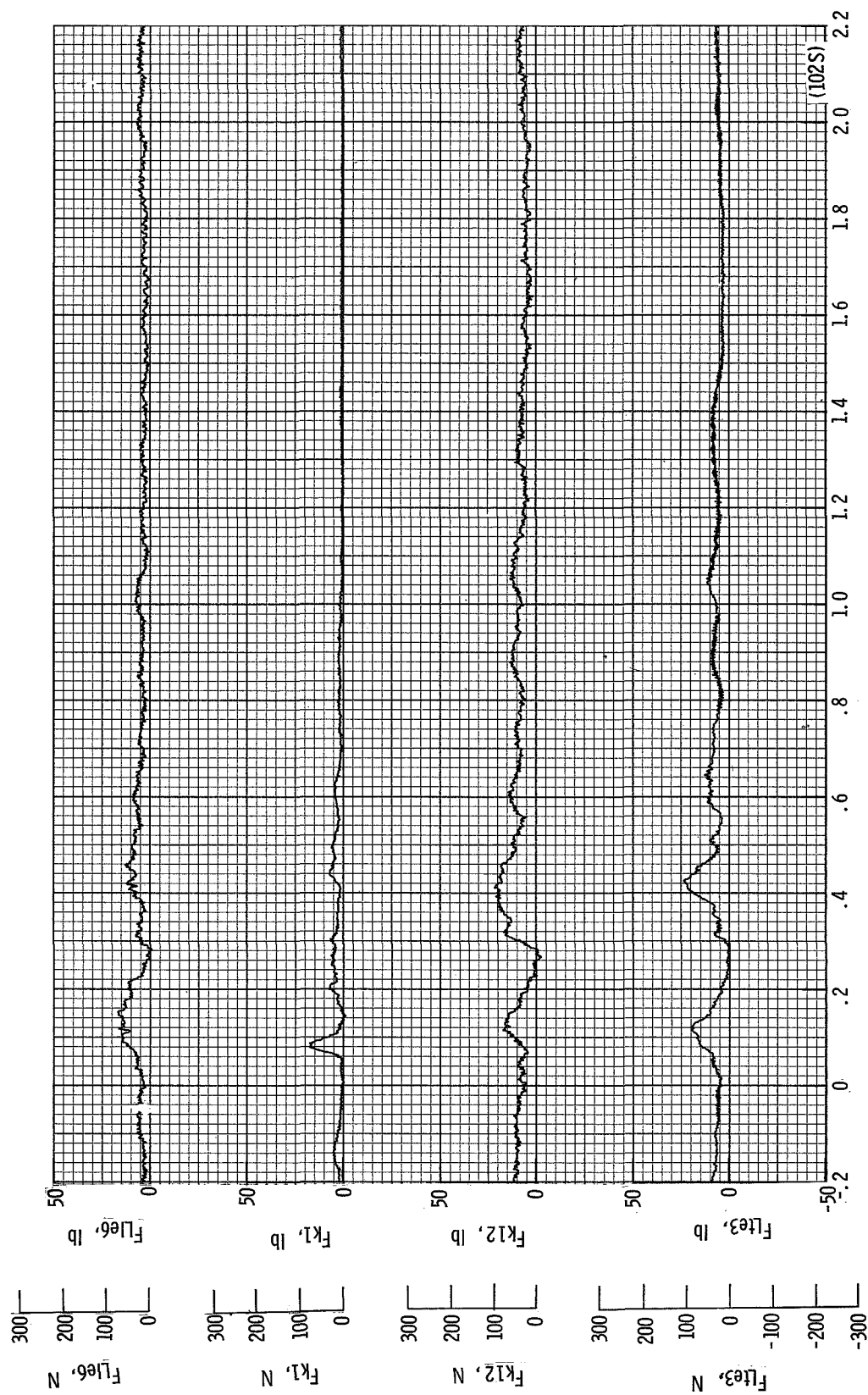
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 28.09 seconds after launch.

Figure 16.- Continued.



(e) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 28.09 seconds after launch.

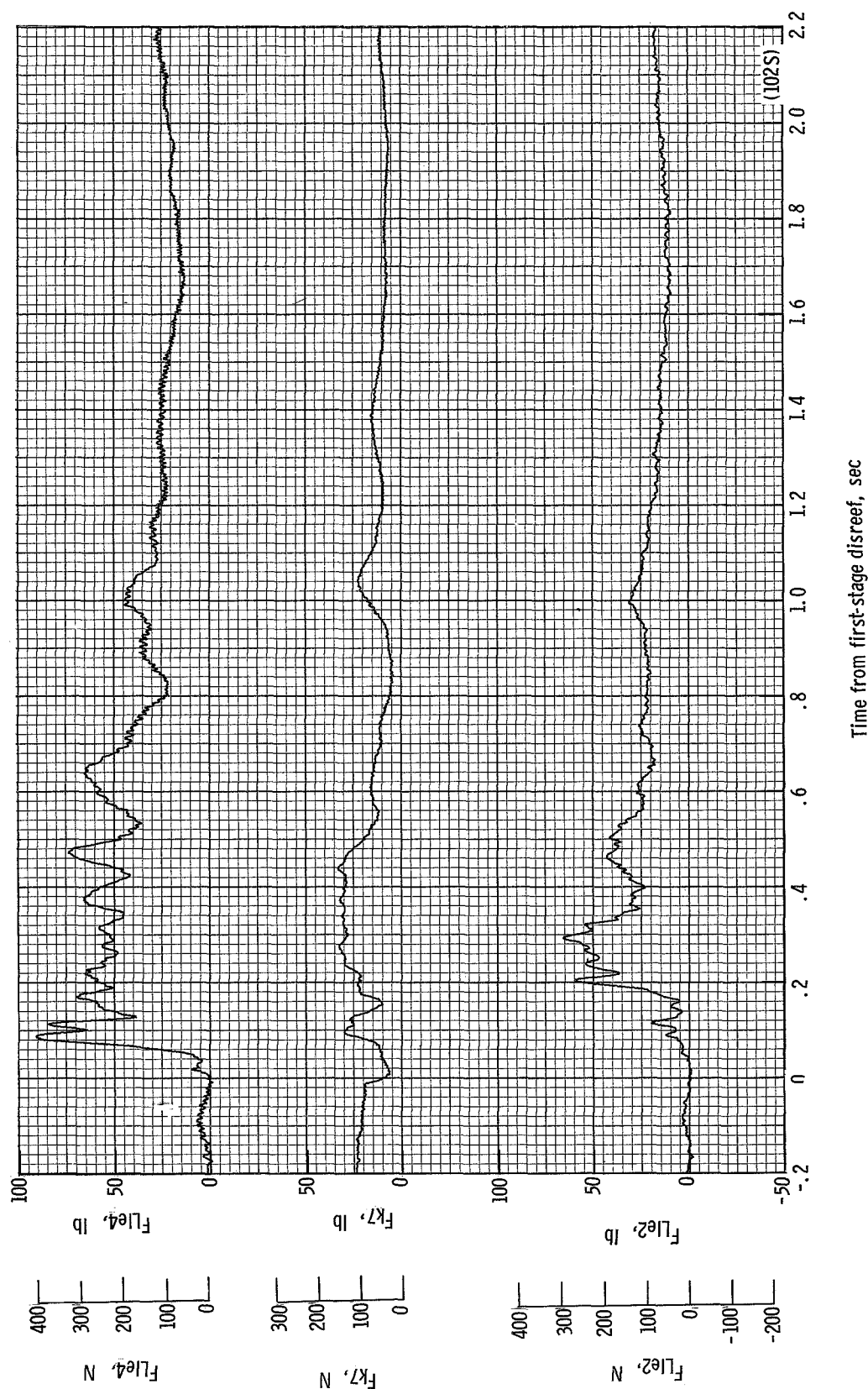
Figure 16.- Continued.



Time from first-stage disreef, sec

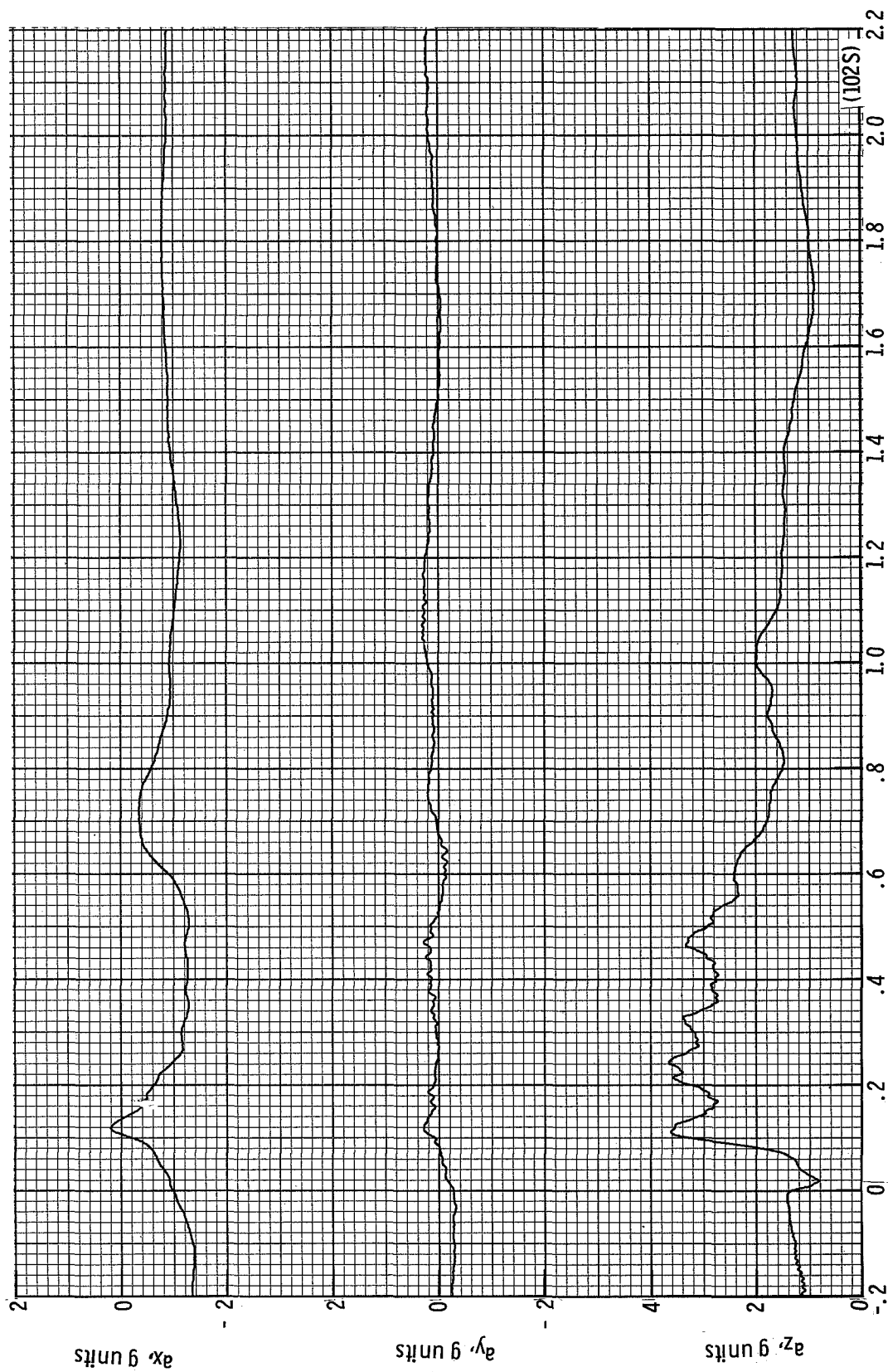
(f) Individual suspension-line loads F_{Lte3} , F_{k12} , F_{k1} , and F_{Lte6} plotted against time from first-stage disreef. Time = 0 second corresponds to 30.66 seconds after launch.

Figure 16.- Continued.



(g) Individual suspension-line loads F_{Lie2} , F_{K7} , and F_{Lie4} plotted against time from first-stage disreef. Time = 0 second corresponds to 30.66 seconds after launch.

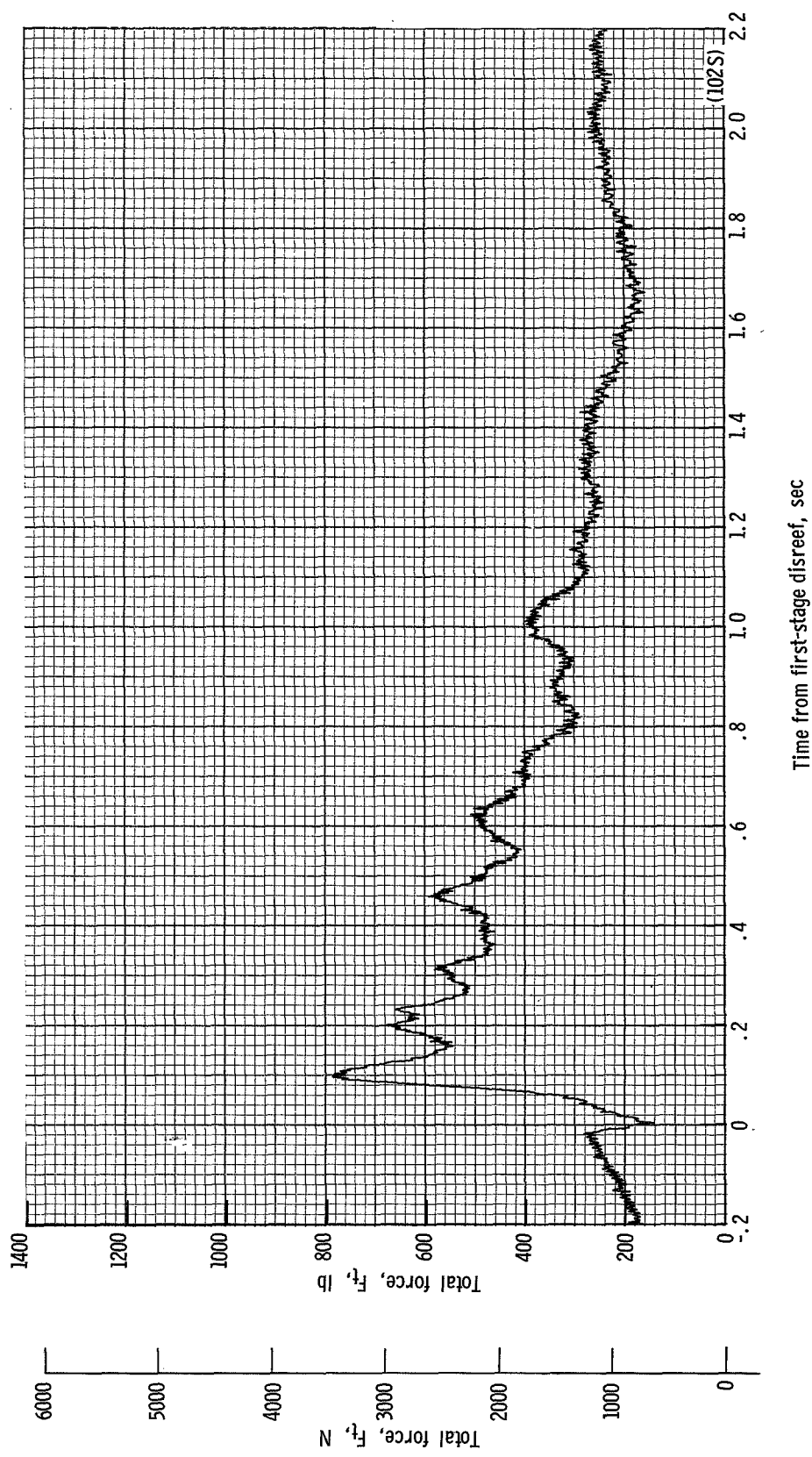
Figure 16.- Continued.



Time from first-stage disreef, sec

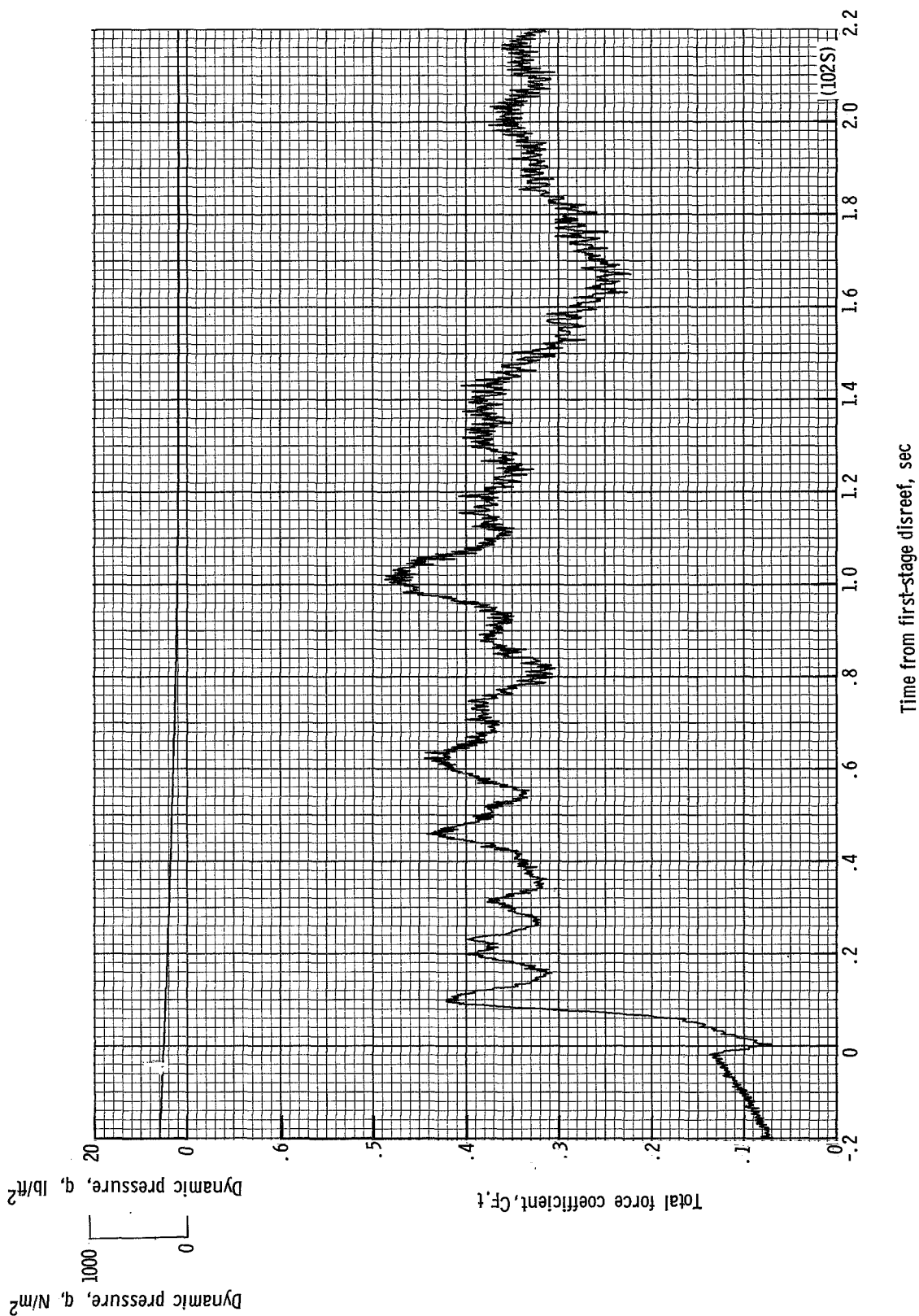
(h) Accelerations a_x , a_y , and a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 30.66 seconds after launch.

Figure 16.- Continued.



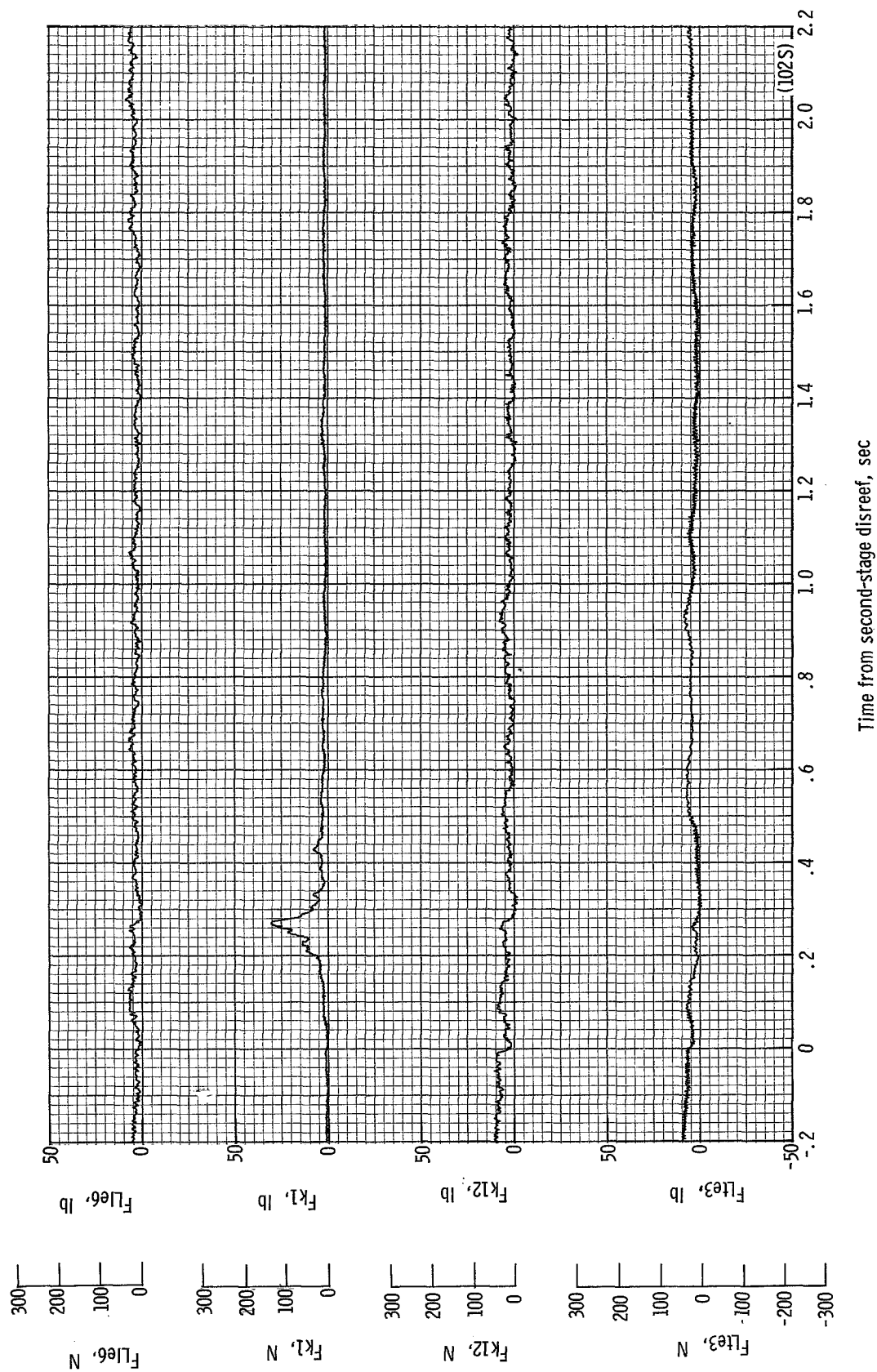
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 30.66 seconds after launch.

Figure 16.- Continued.



(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 30.66 seconds after launch.

Figure 16.- Continued.



(k) Individual suspension-line loads F_{Lie3} , F_{k12} , F_{k1} , and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 33.96 seconds after launch.

Figure 16.- Continued.

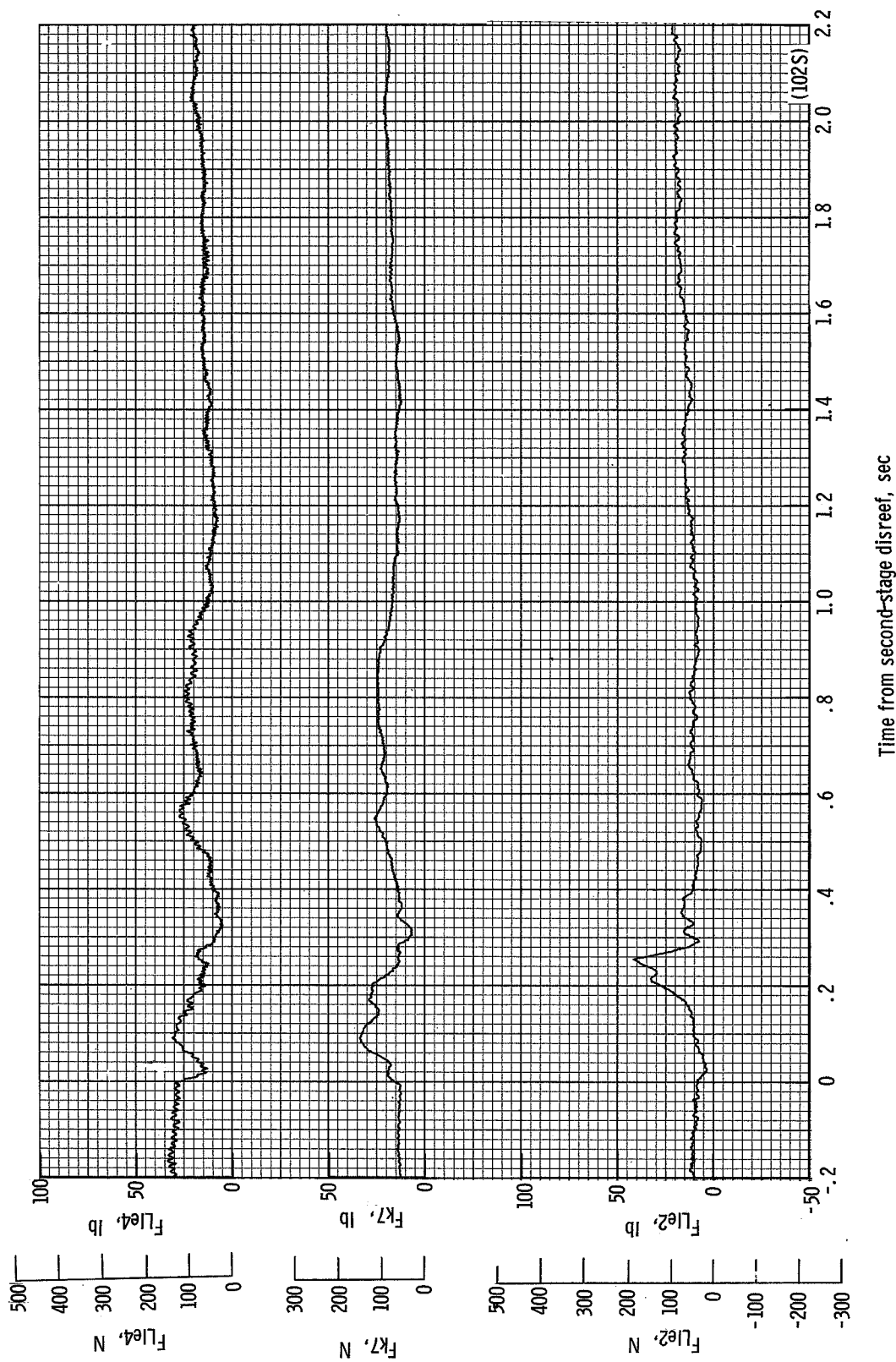
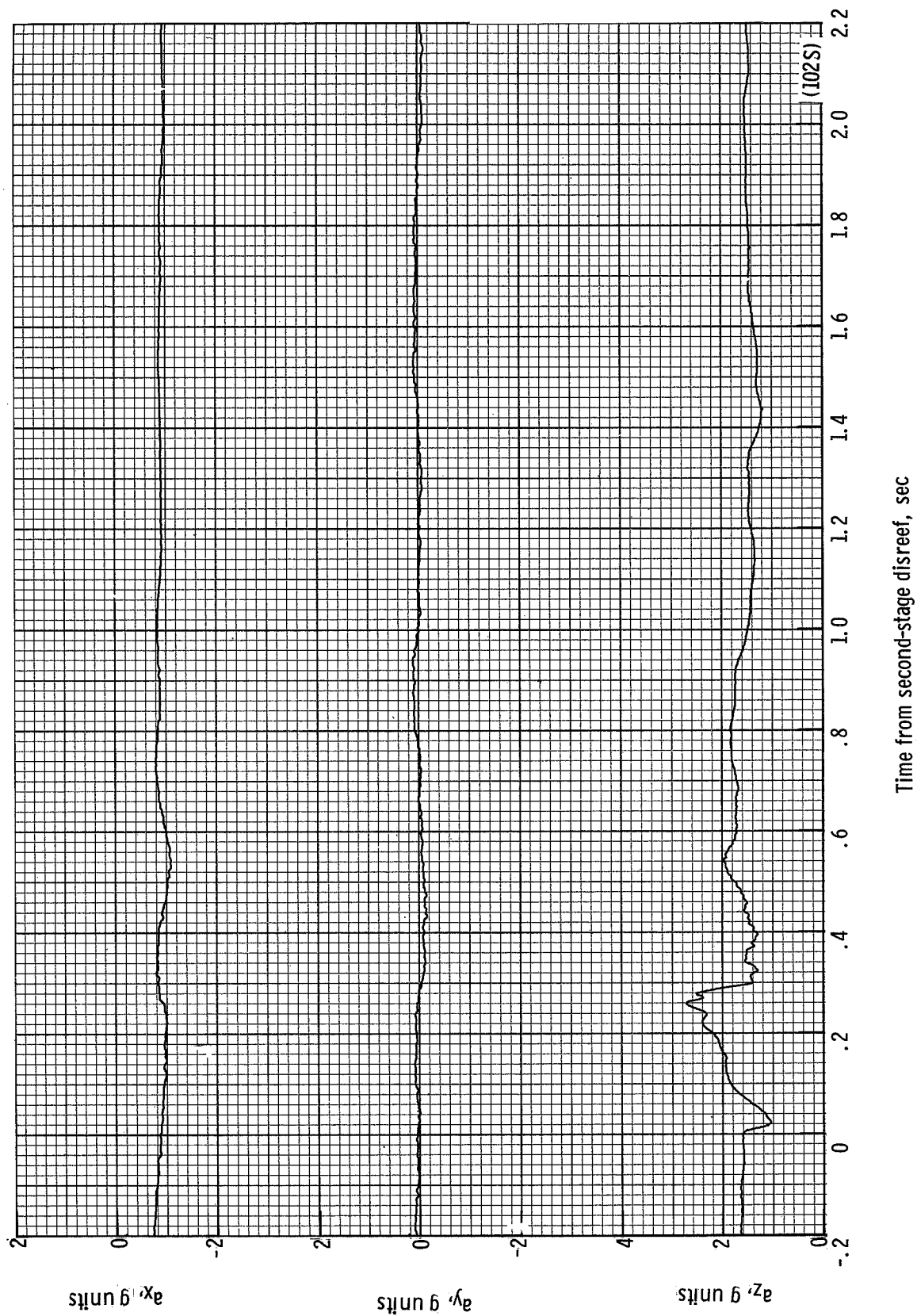
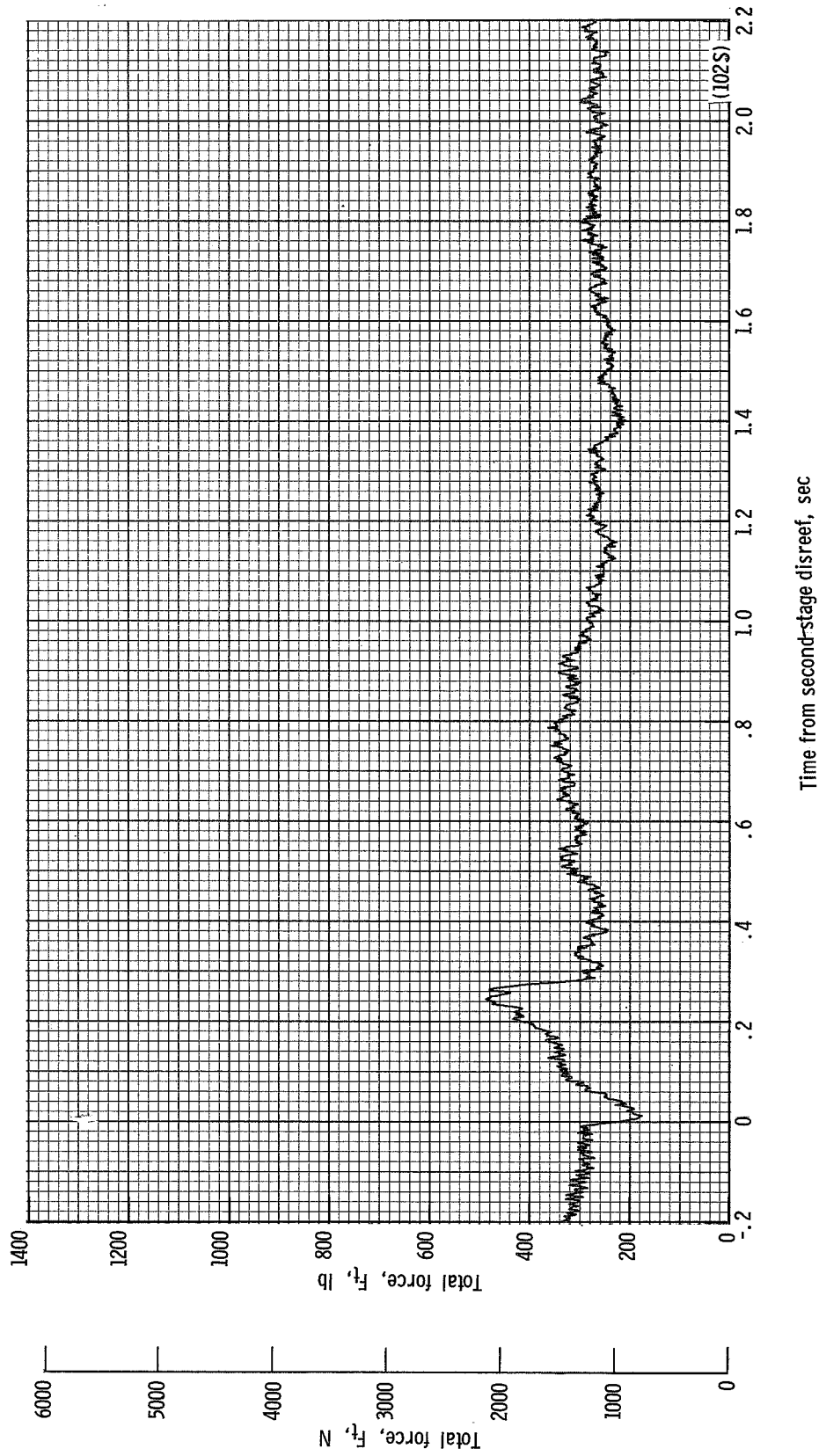


Figure 16.- Continued.



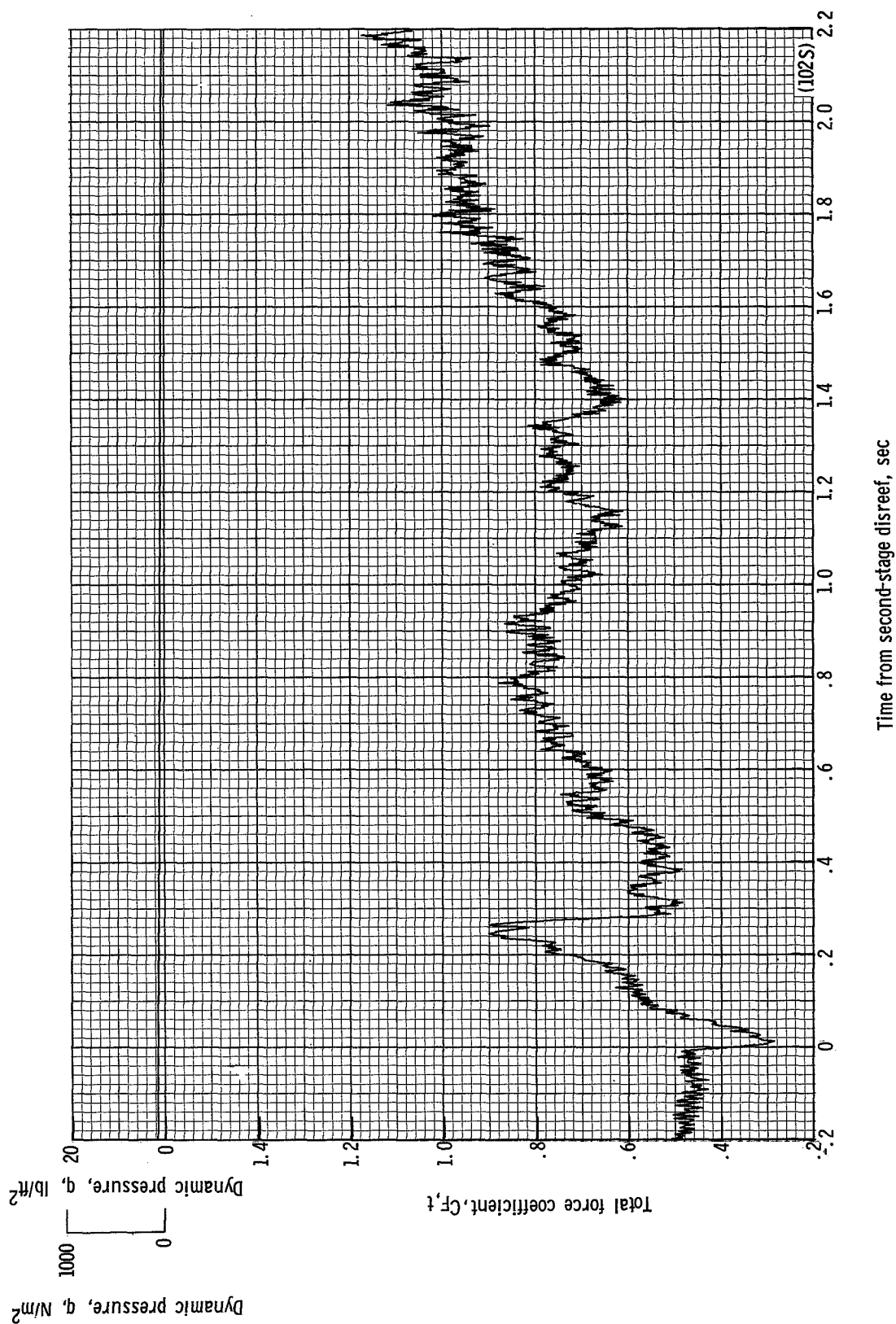
(m) Accelerations a_x , a_y , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 33.96 seconds after launch.

Figure 16.- Continued.



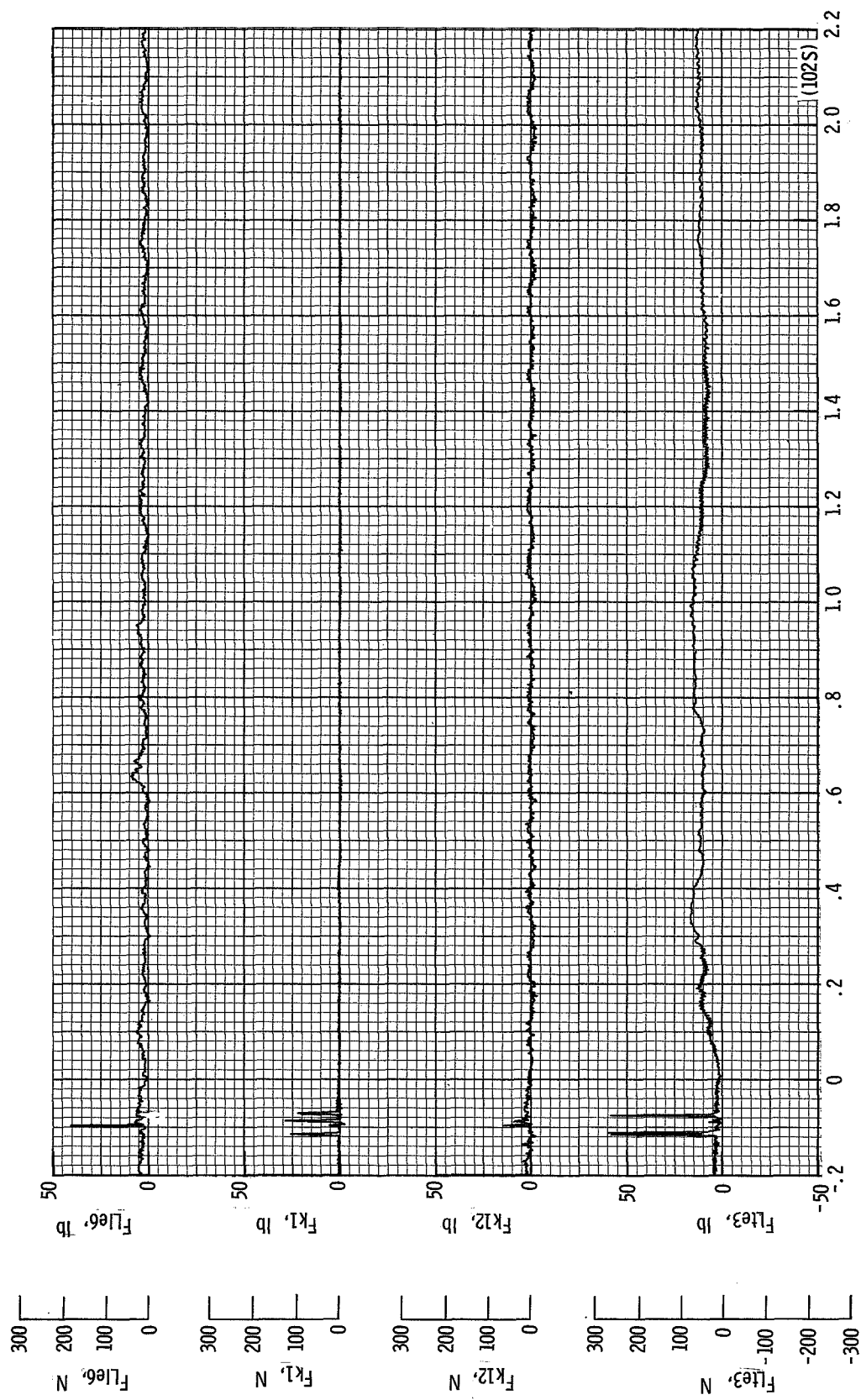
(ii) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 33.96 seconds after launch.

Figure 16.- Continued.



(a) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 33.96 seconds after launch.

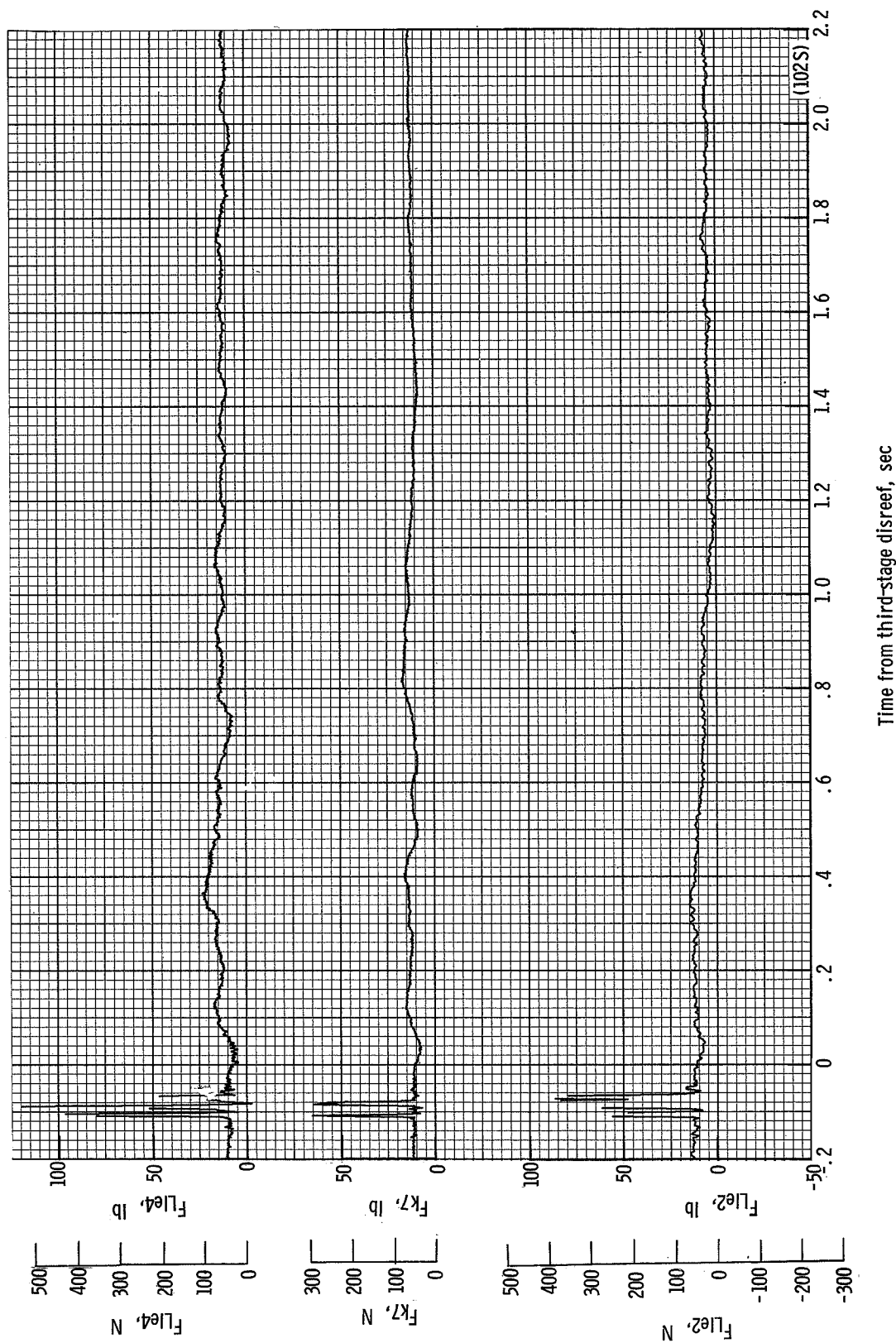
Figure 16.- Continued.



Time from third-stage disreef, sec

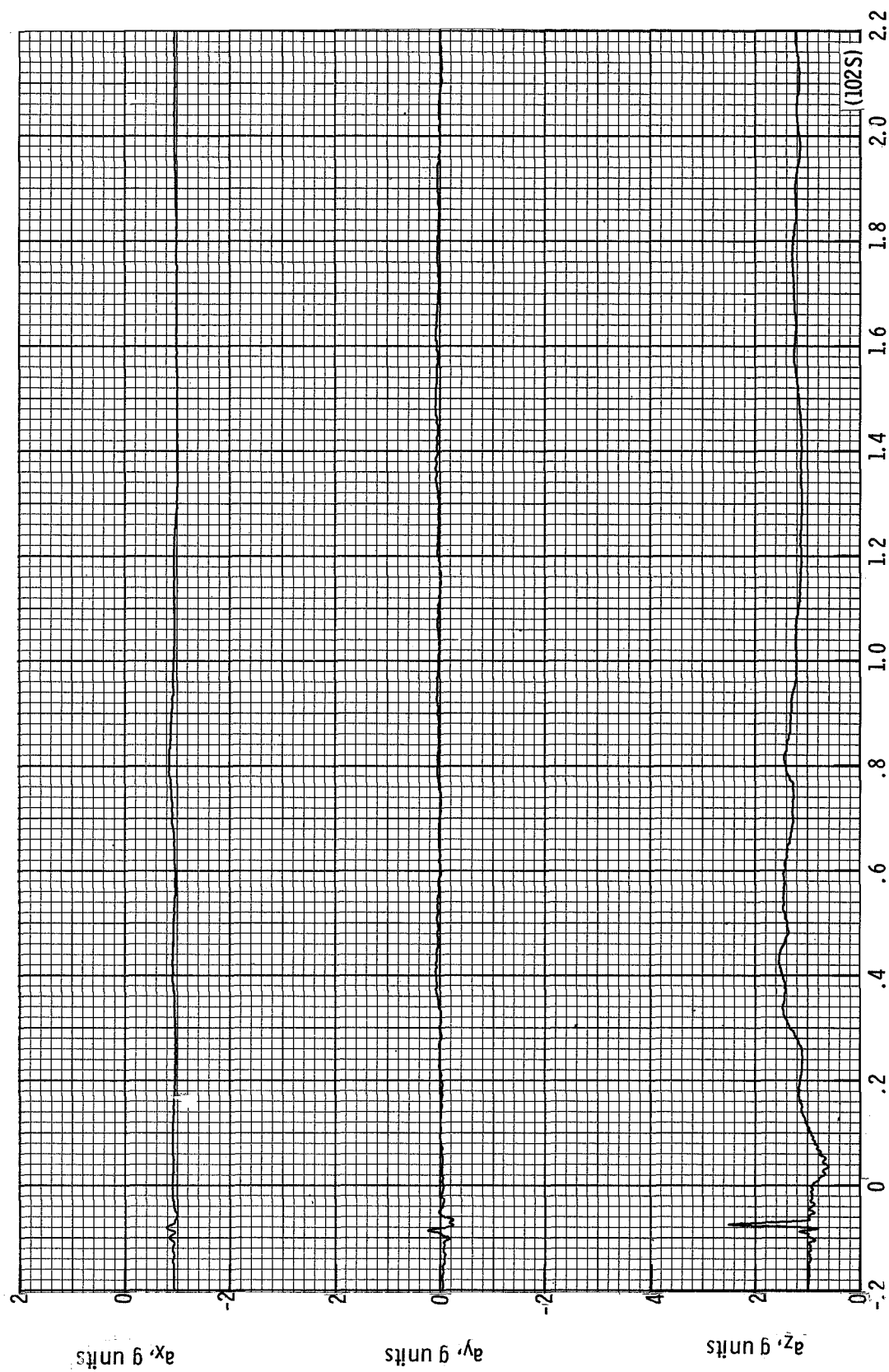
(p) Individual suspension-line loads F_{Lte3} , F_{K12} , F_{K1} , and F_{Lte6} plotted against time from third-stage disreef. Time = 0 second corresponds to 37.18 seconds after launch.

Figure 16.- Continued.



(a) Individual suspension-line loads F_{Lle2} , F_{k7} , and F_{Lle4} plotted against time from third-stage disreef. Time = 0 second corresponds to 37.18 seconds after launch.

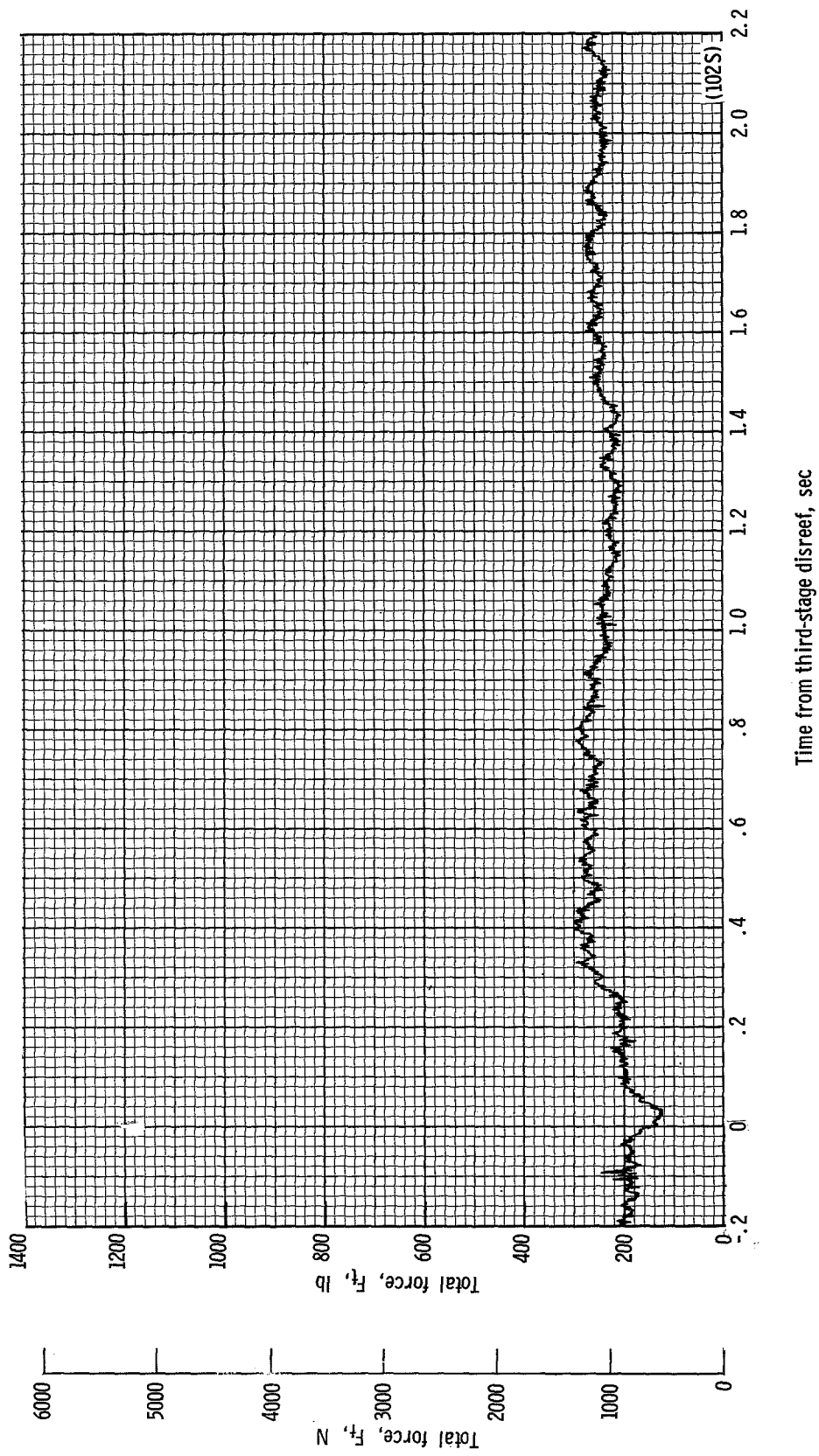
Figure 16.- Continued.



Time from third-stage disreef, sec

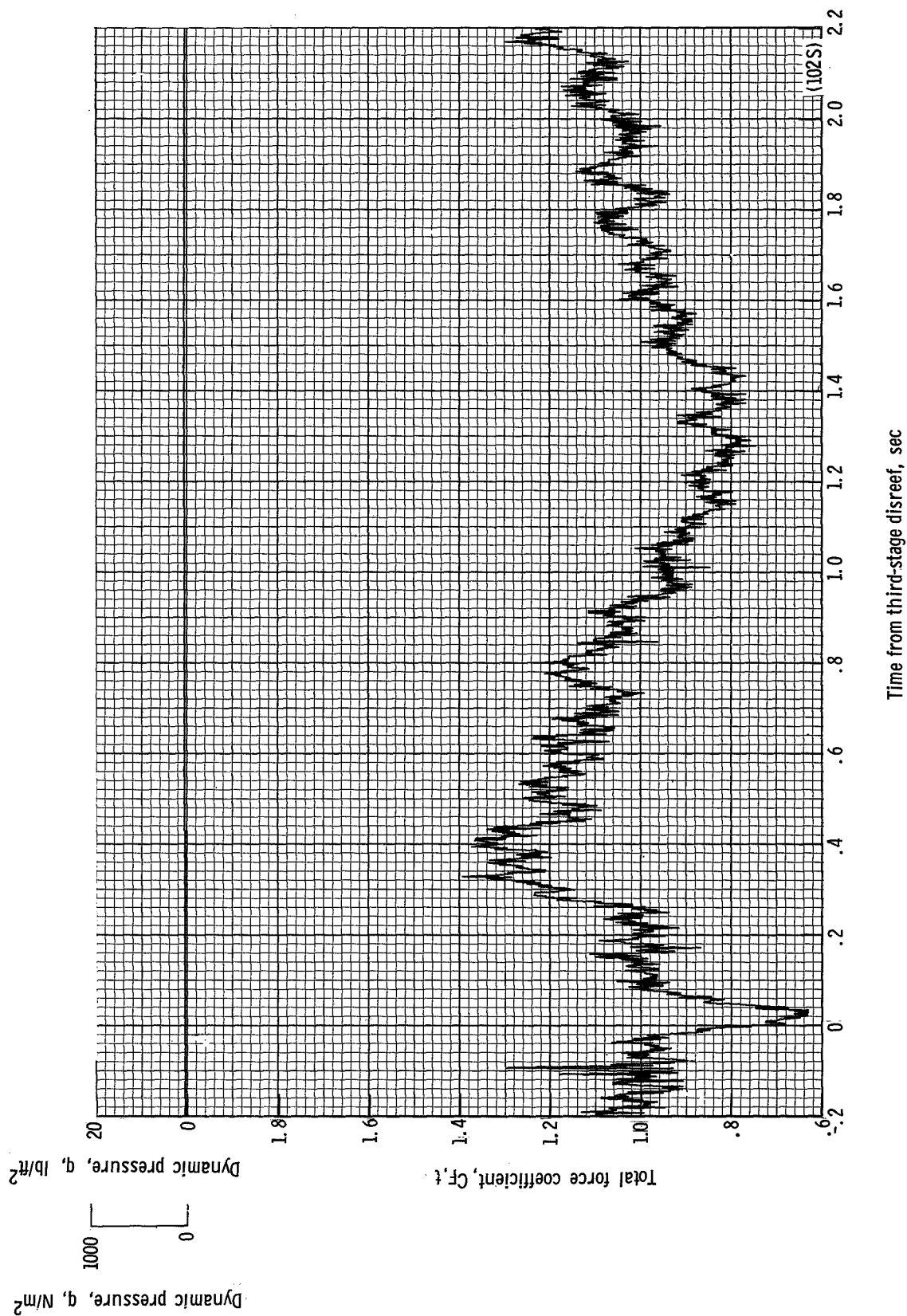
(r) Accelerations a_x , a_y , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 37.18 seconds after launch.

Figure 16.- Continued.



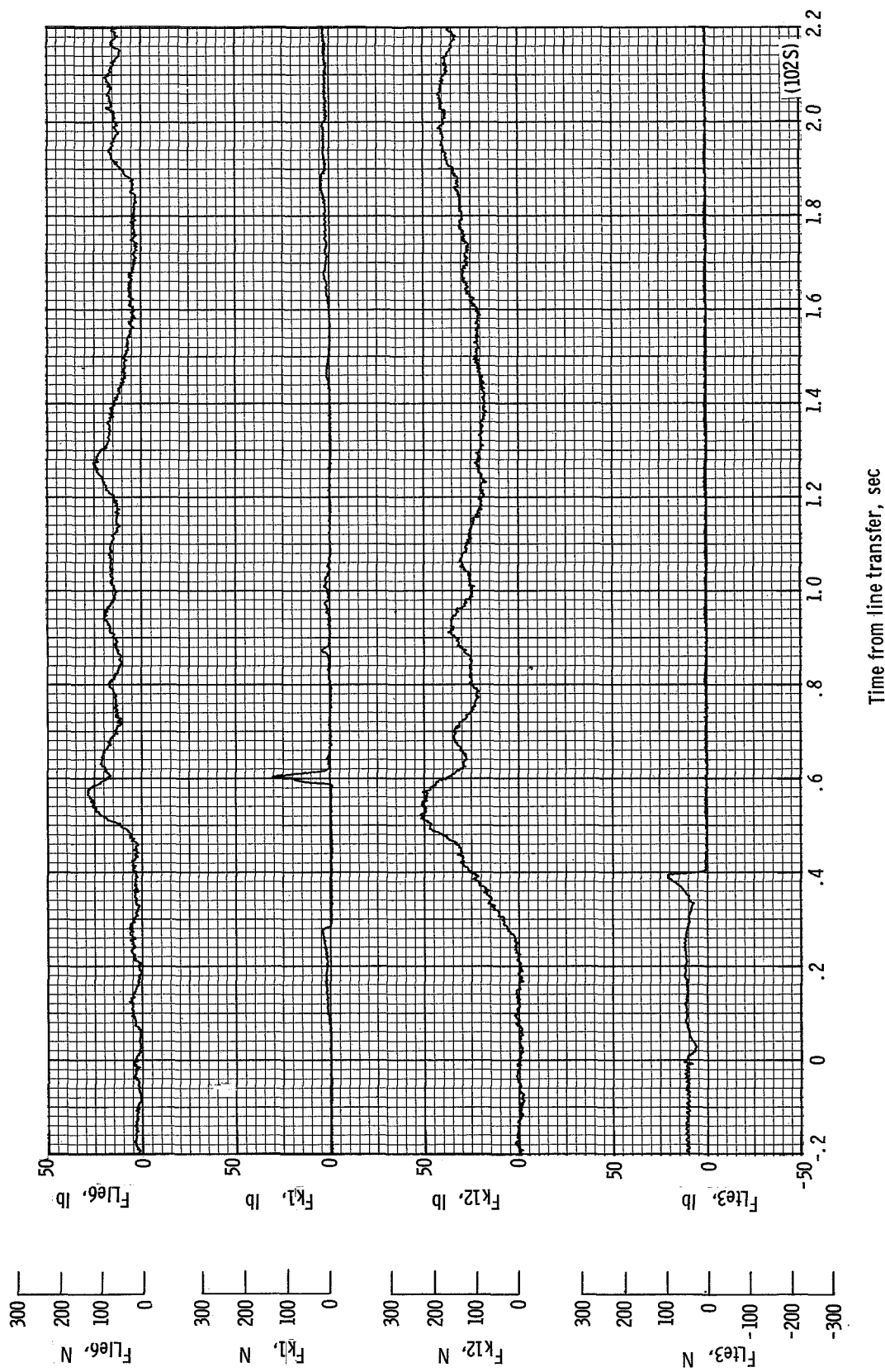
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 37.18 seconds after launch.

Figure 16.- Continued.



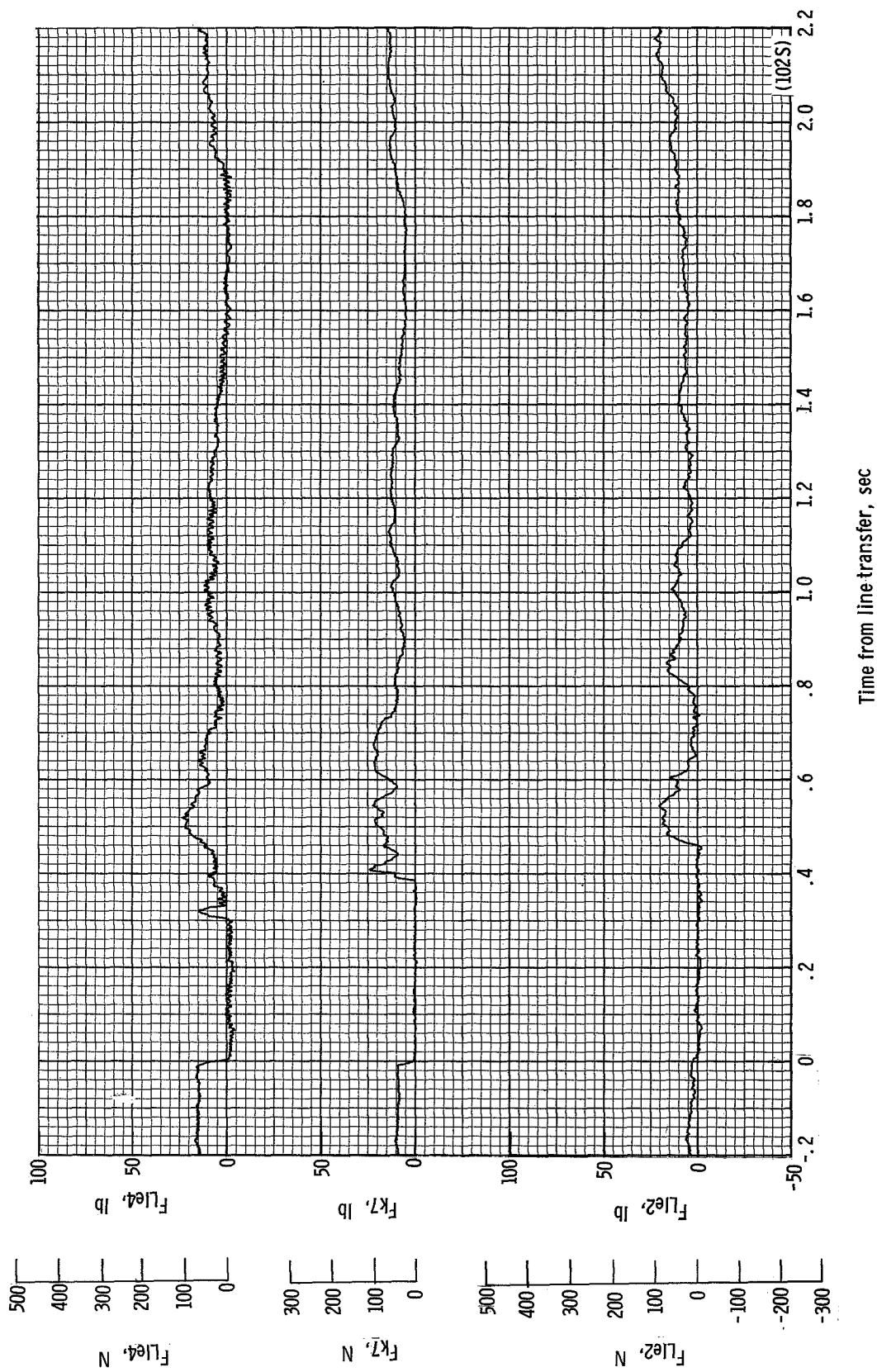
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 37.18 seconds after launch.

Figure 16.- Continued.



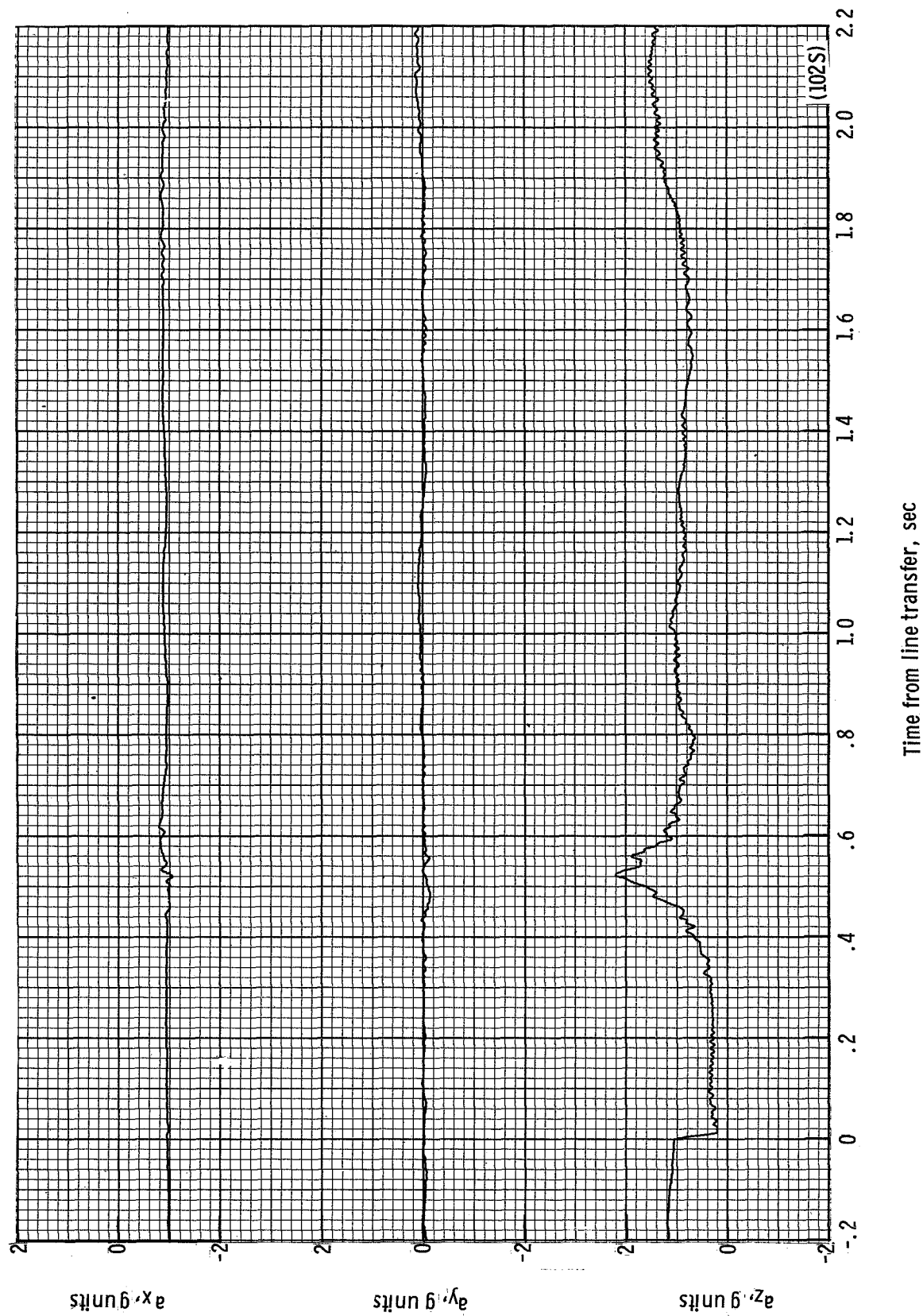
(u) Individual suspension-line loads F_{Lte3} , F_{K12} , F_{K1} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 39.45 seconds after launch.

Figure 16.- Continued.



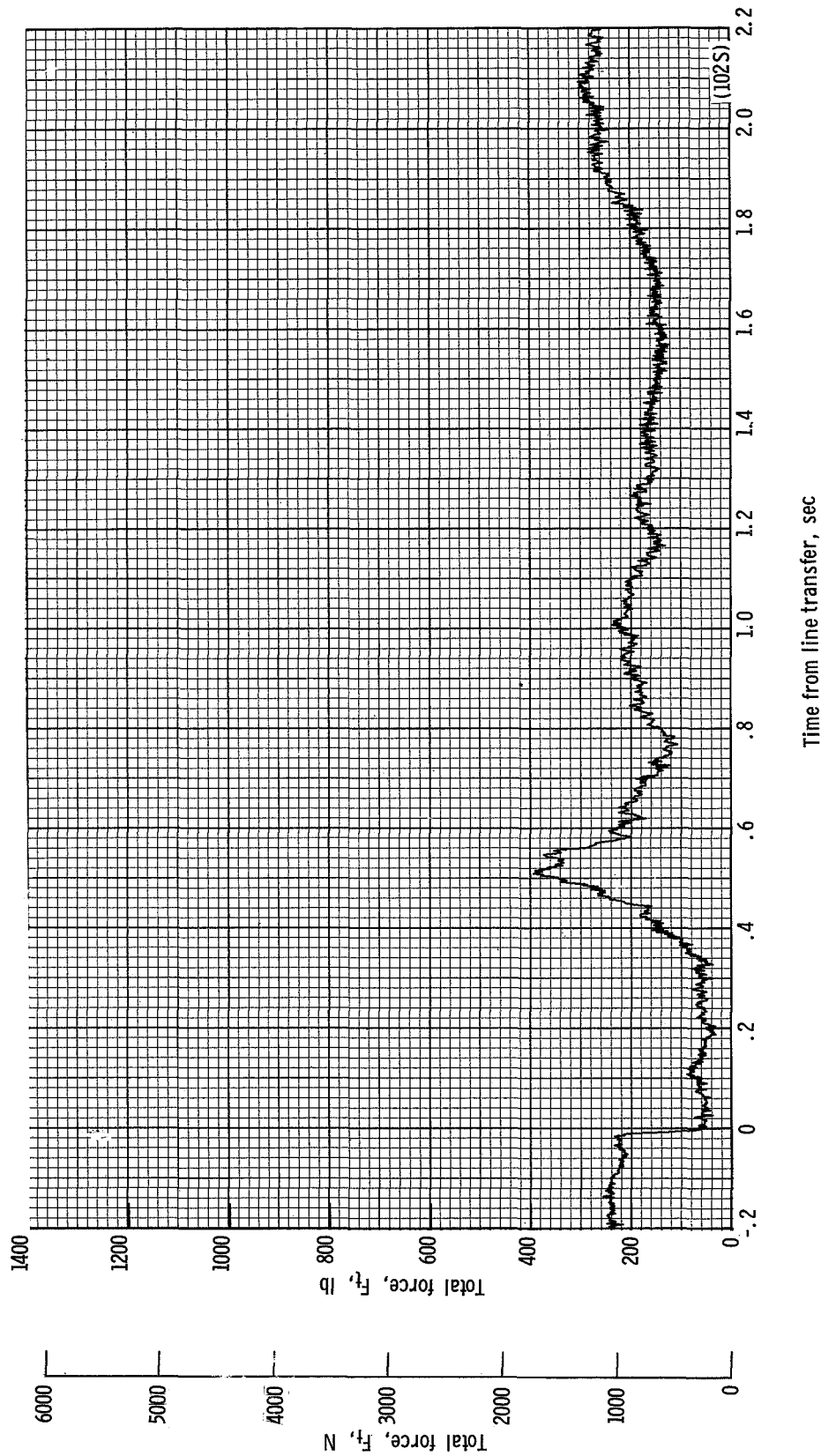
(v) Individual suspension-line loads F_{Lle2} , F_{k7} , and F_{Lle4} plotted against time from line transfer. Time = 0 second corresponds to 39.45 seconds after launch.

Figure 16.- Continued.



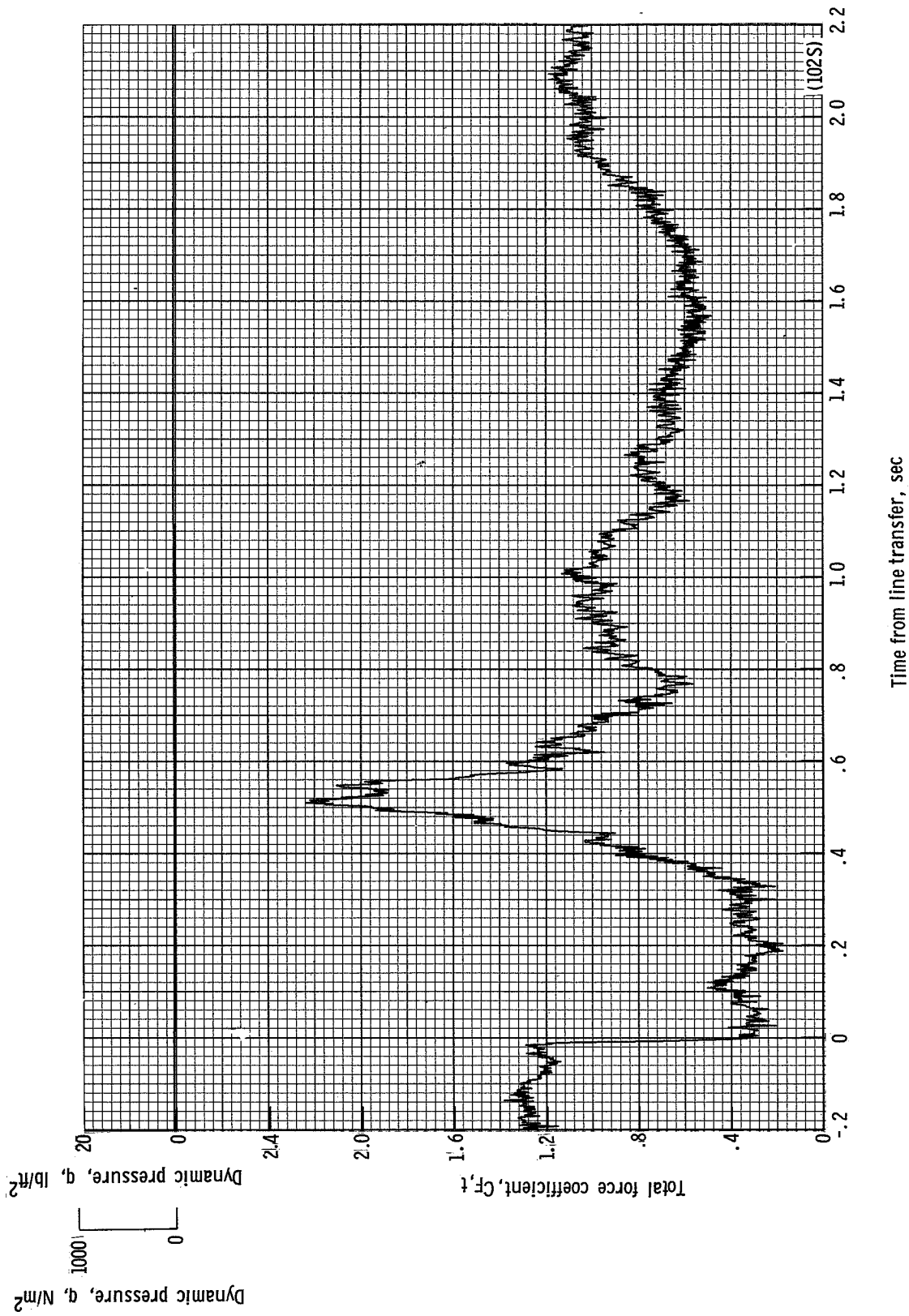
(w) Accelerations a_x , a_y , and a_z plotted against time from line transfer. Time = 0 second corresponds to 39.45 seconds after launch.

Figure 16.- Continued.



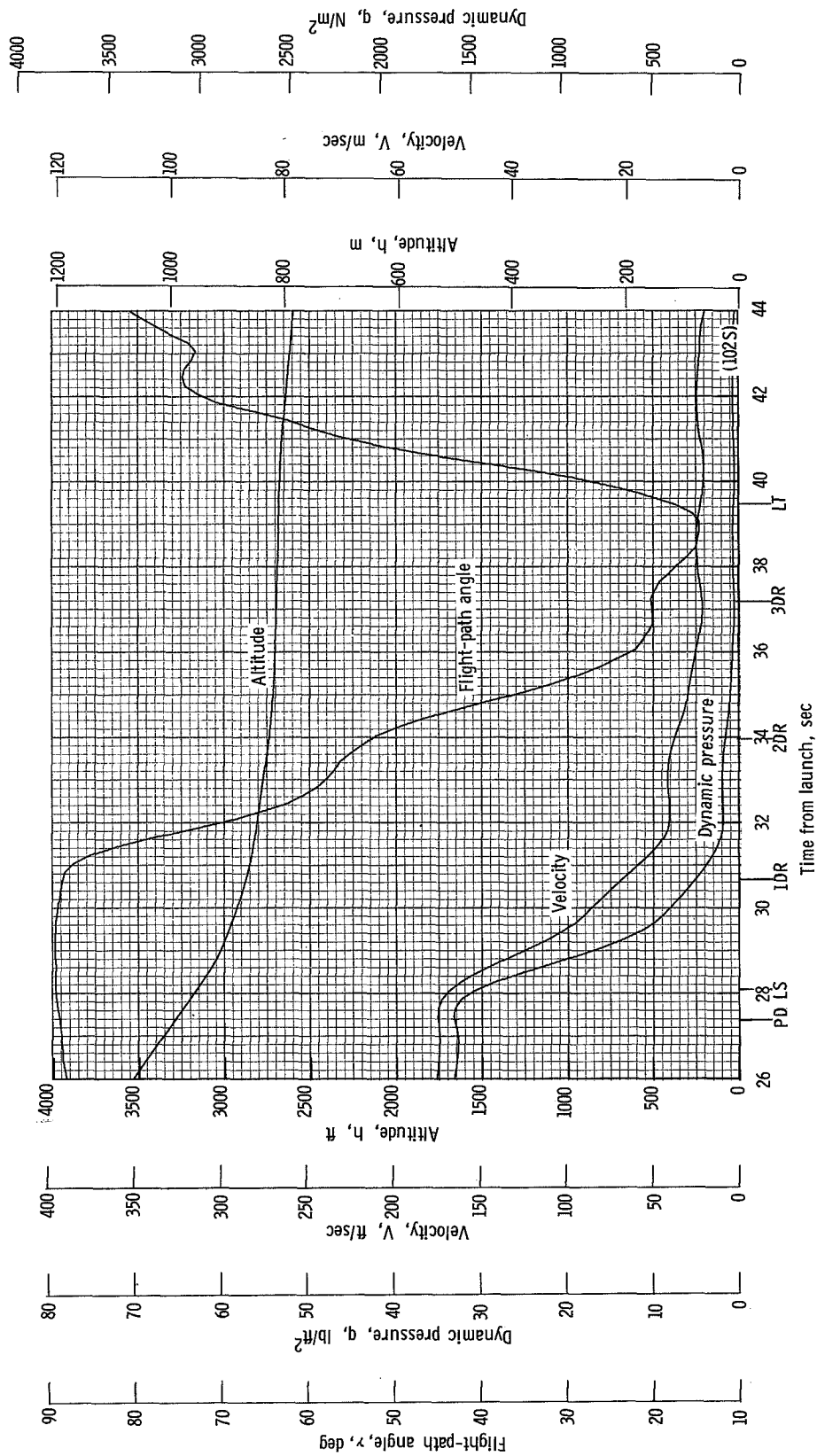
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 39.45 seconds after launch.

Figure 16.- Continued.



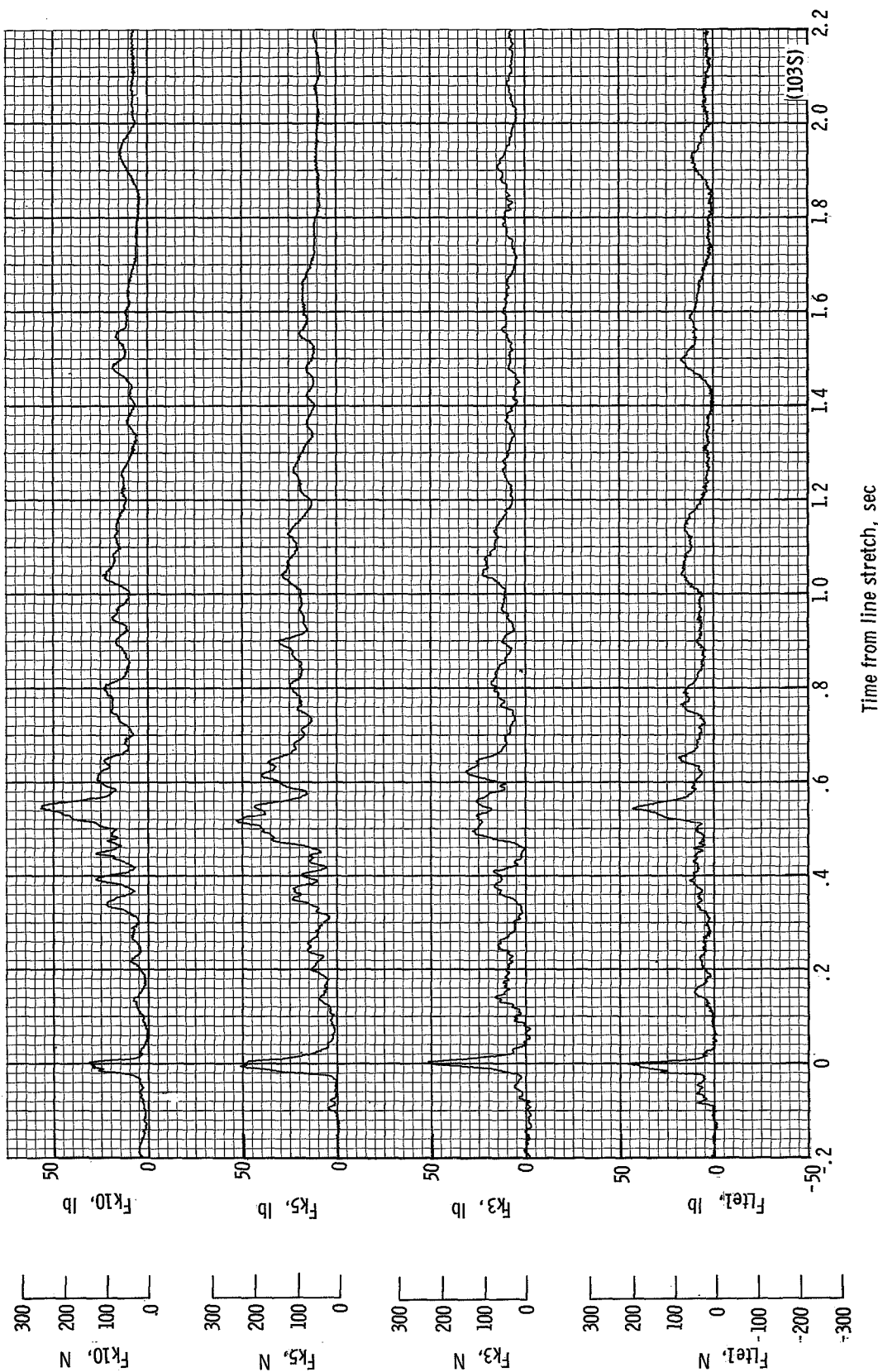
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 39.45 seconds after launch.

Figure 16.- Continued.



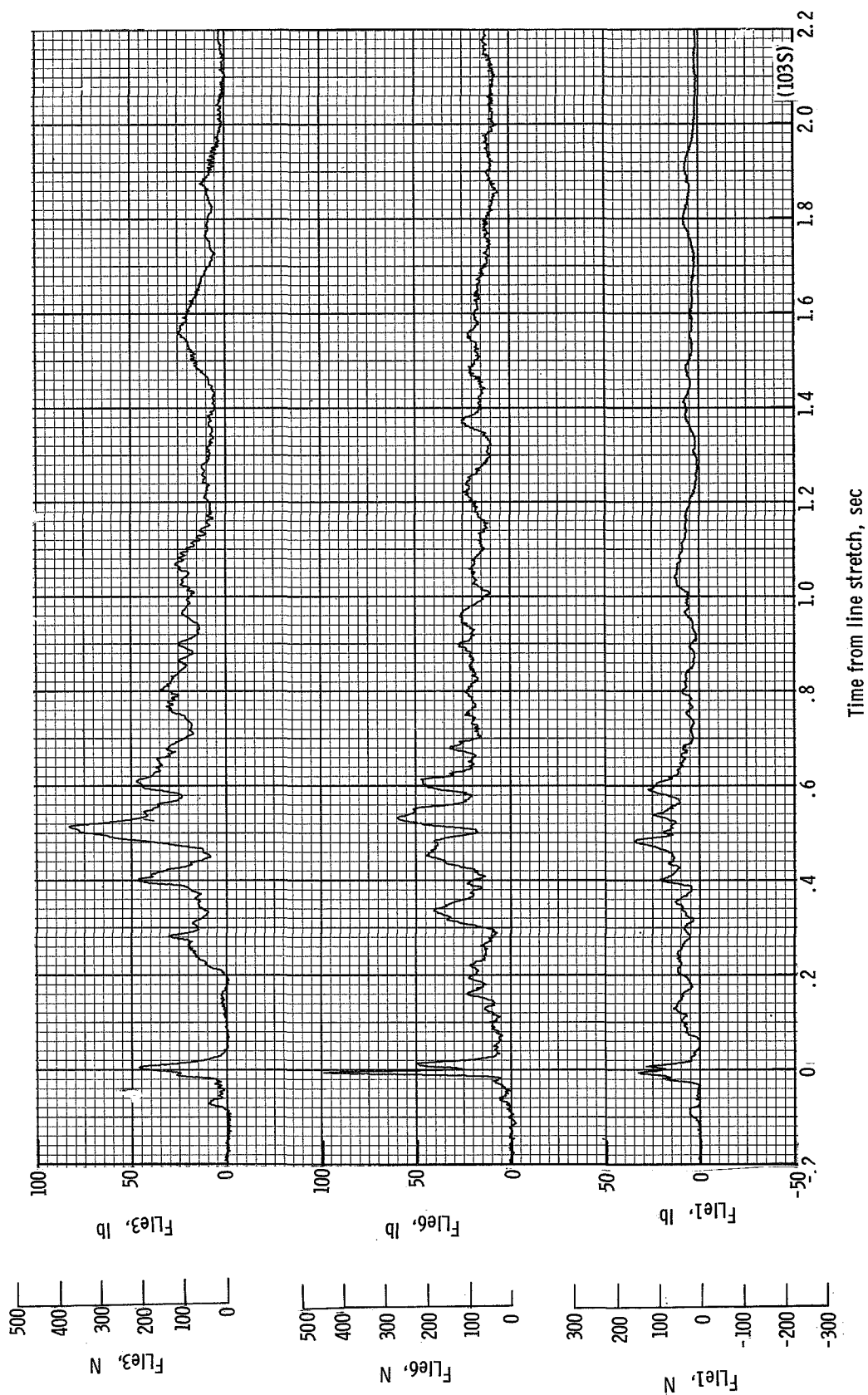
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 16.- Concluded.



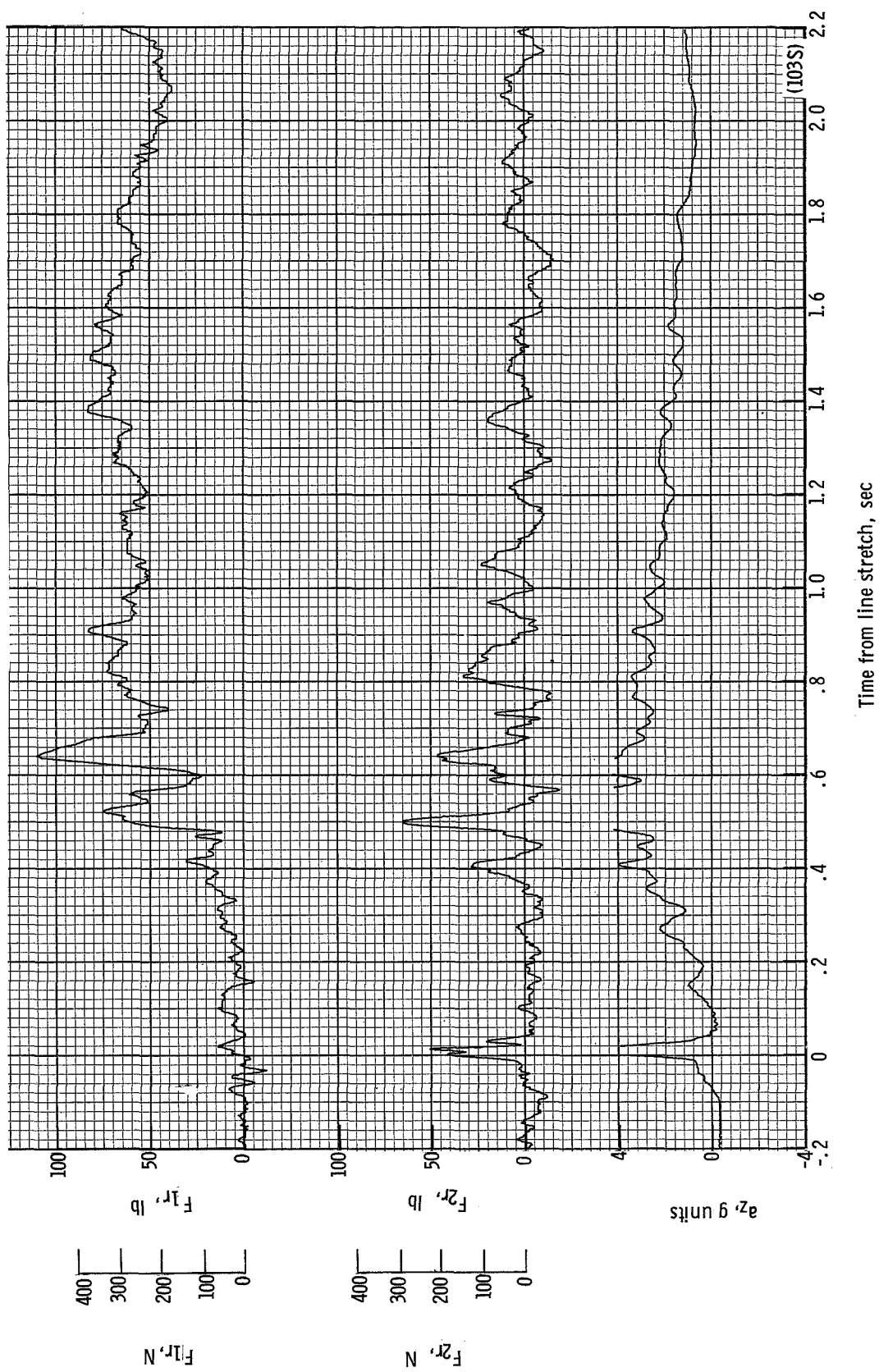
(a) Individual suspension-line loads F_{tel} , F_{k3} , F_{k5} , and F_{k10} plotted against time from line stretch. Time = 0 second corresponds to 24.92 seconds after launch.

Figure 17.- Time history of single-keel parawing deployment data for test 103S. $W_D = 1112.1$ N (250.0 lb); $W_P = 971.4$ N (218.5 lb); $q_{PD} = 2183.3$ N/m² (45.6 lb/ft²); $h_{PD} = 931$ m (3055 ft); $t_{r/\dot{z}_k} = 0.141$; reefing version 11.



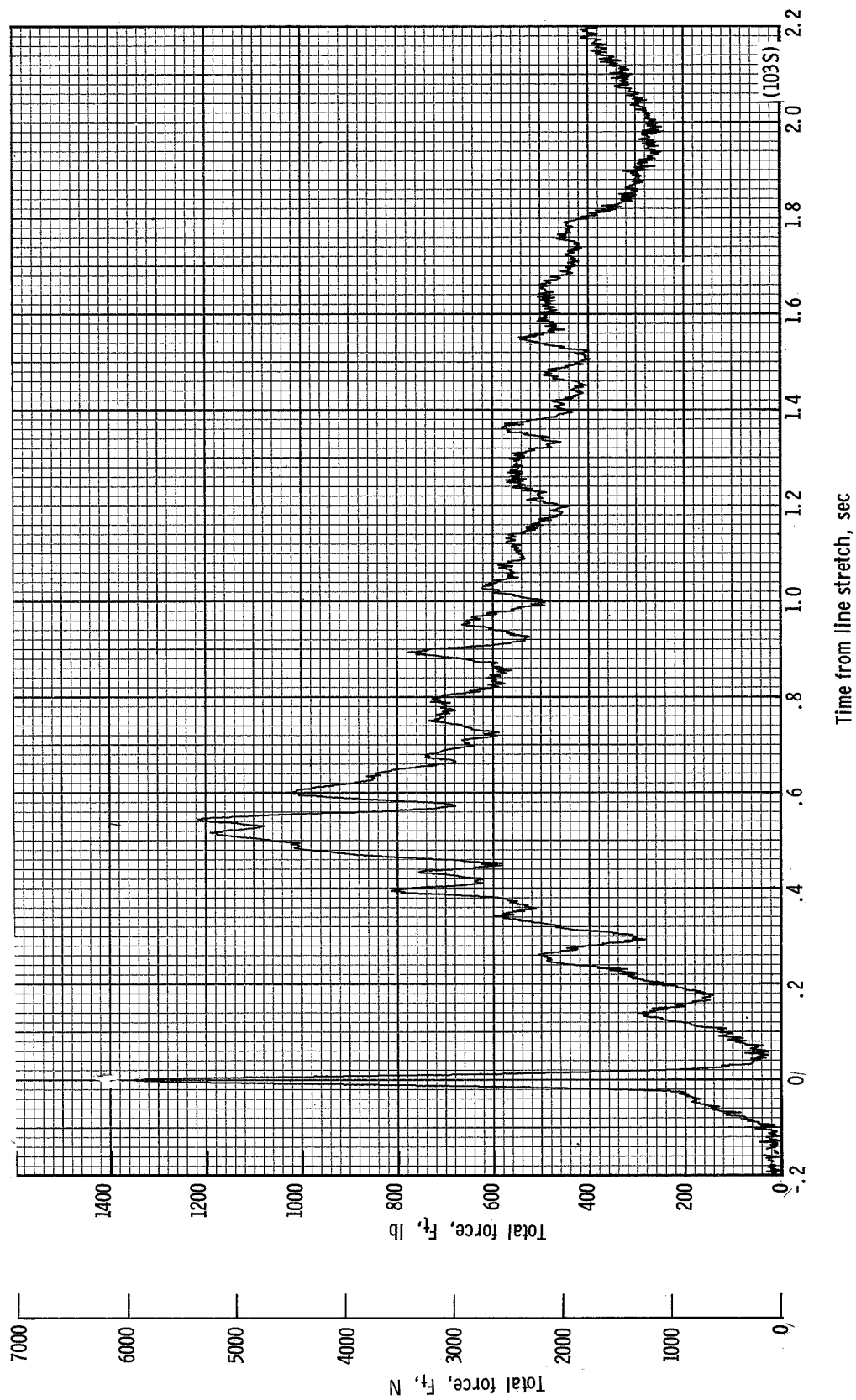
(b) Individual suspension-line loads F_{Lie1} , F_{Lie6} and F_{Lie3} plotted against time from line stretch. Time = 0 second corresponds to 24.92 seconds after launch.

Figure 17.- Continued.



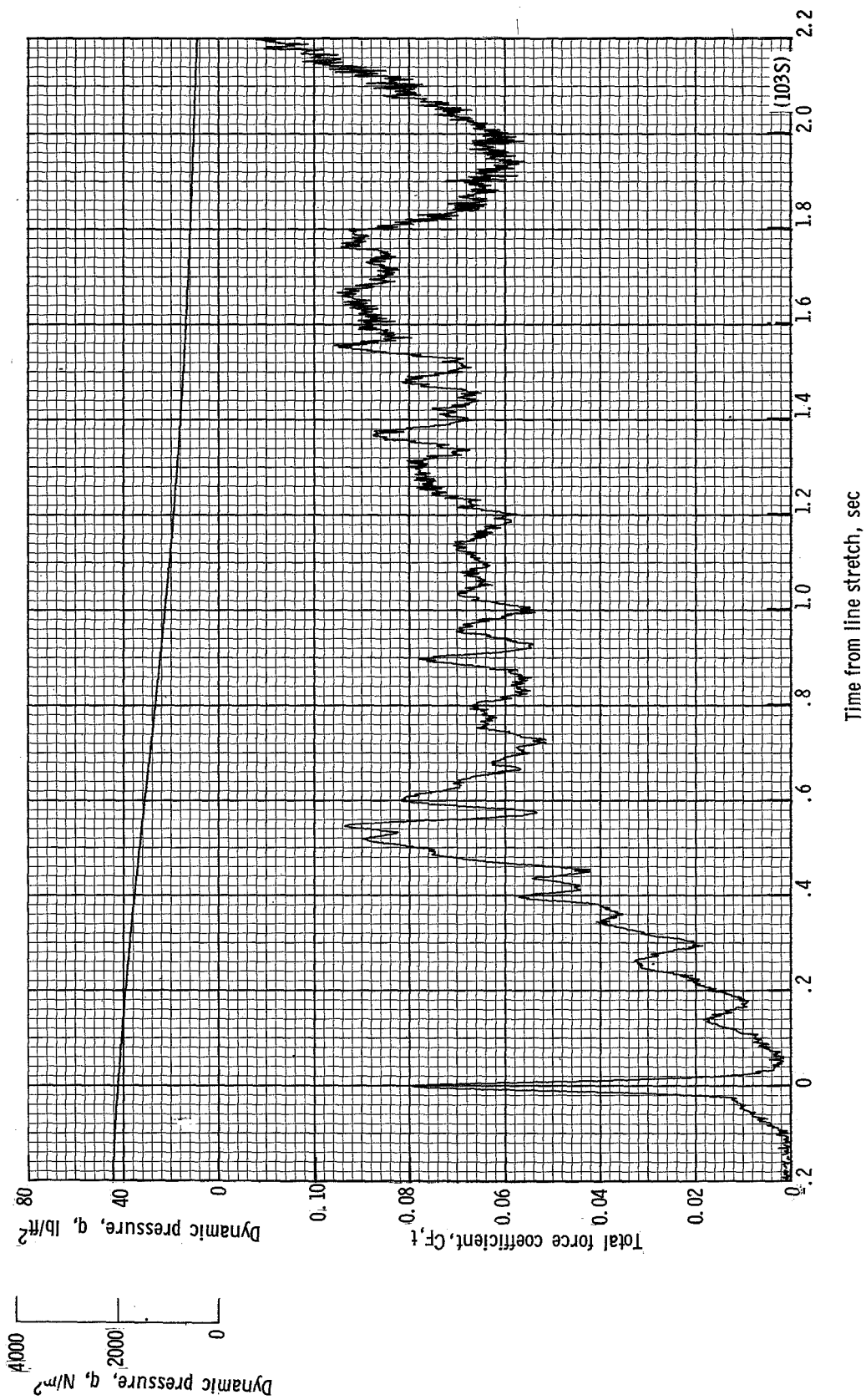
(c) Individual reefing-line loads, F_{2r} and F_{1r} , and acceleration a_z plotted against time from line stretch. Time = 0 second corresponds to 24.92 seconds after launch.

Figure 17.- Continued.



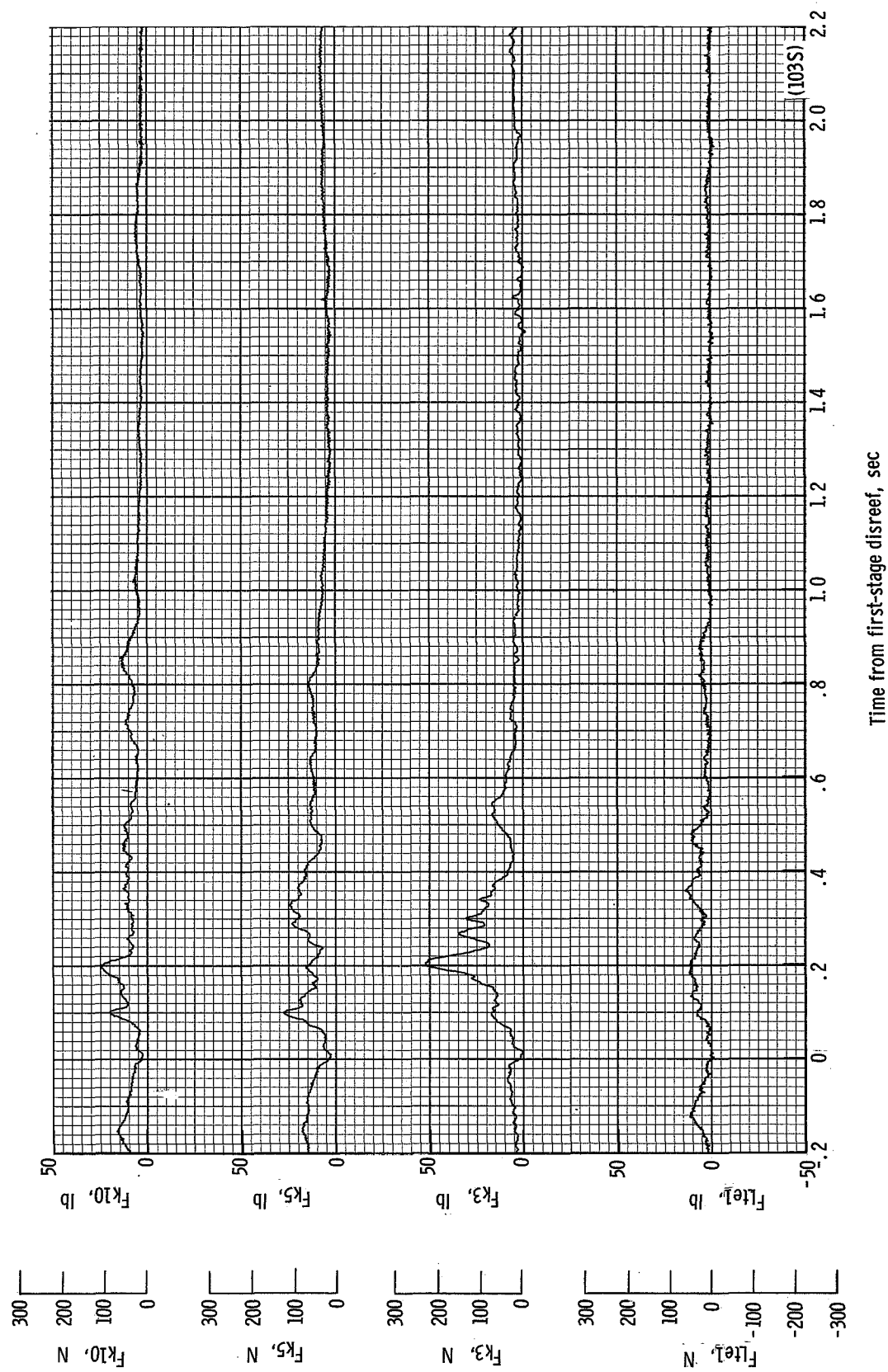
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 24.92 seconds after launch.

Figure 17.- Continued.



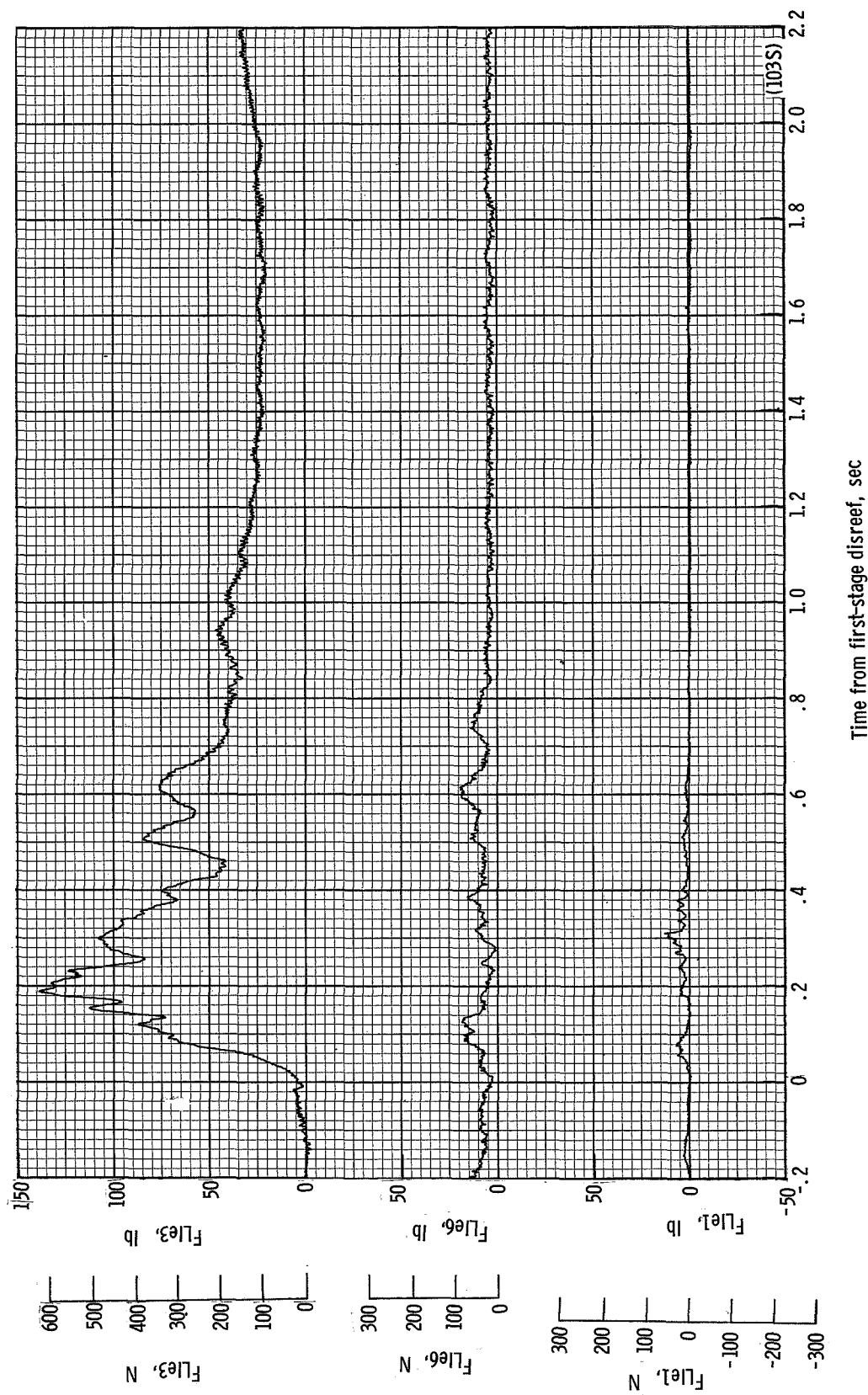
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 24.92 seconds after launch.

Figure 17.- Continued.



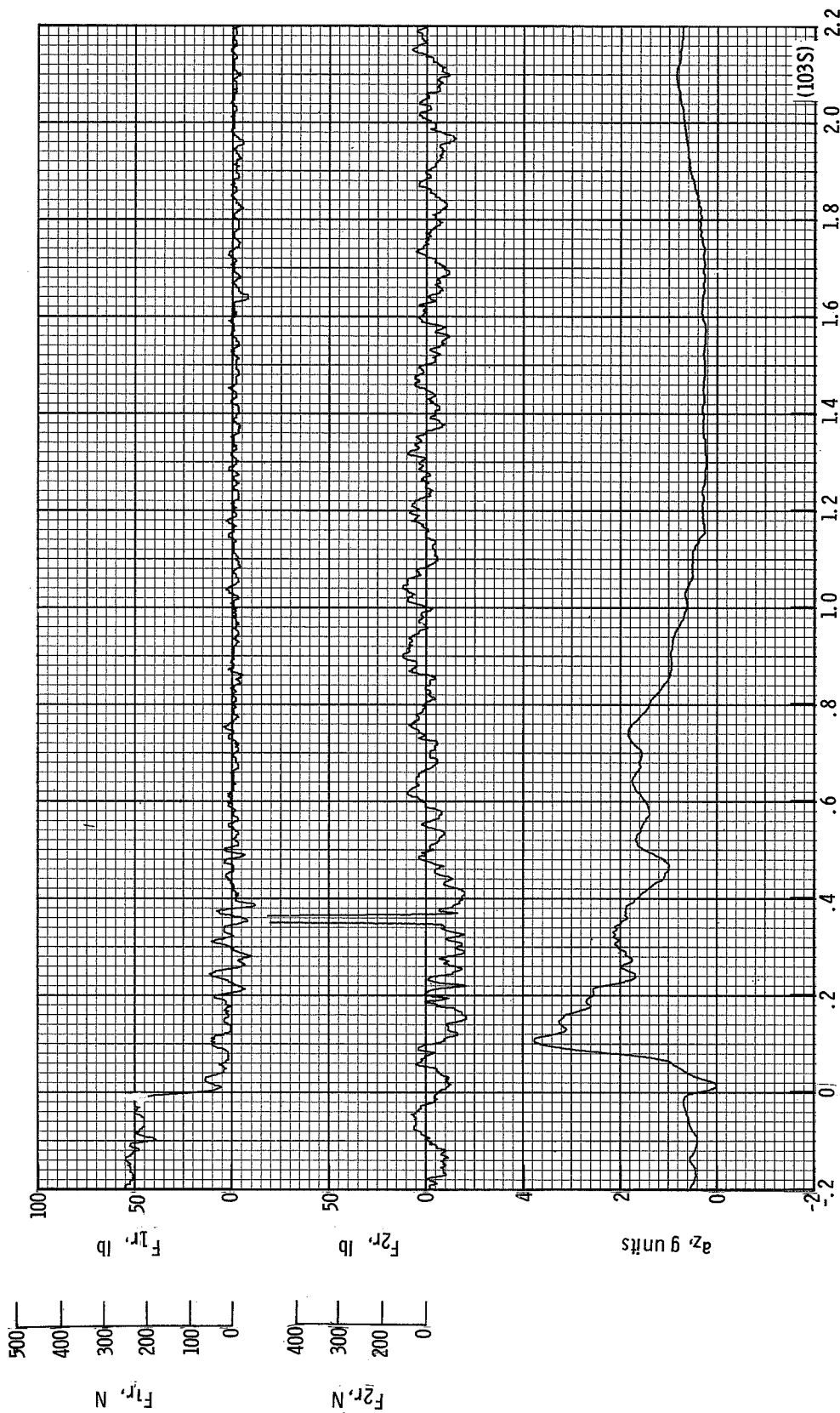
(f) Individual suspension-line loads F_{k10} , F_{k5} , F_{k3} , and F_{k1} plotted against time from first-stage disreef. Time = 0 second corresponds to 27.47 seconds after launch.

Figure 17.- Continued.



(g) Individual suspension-line loads F_{Lie1} , F_{Lie6} , and F_{Lie3} plotted against time from first-stage disreef. Time = 0 second corresponds to 27.47 seconds after launch.

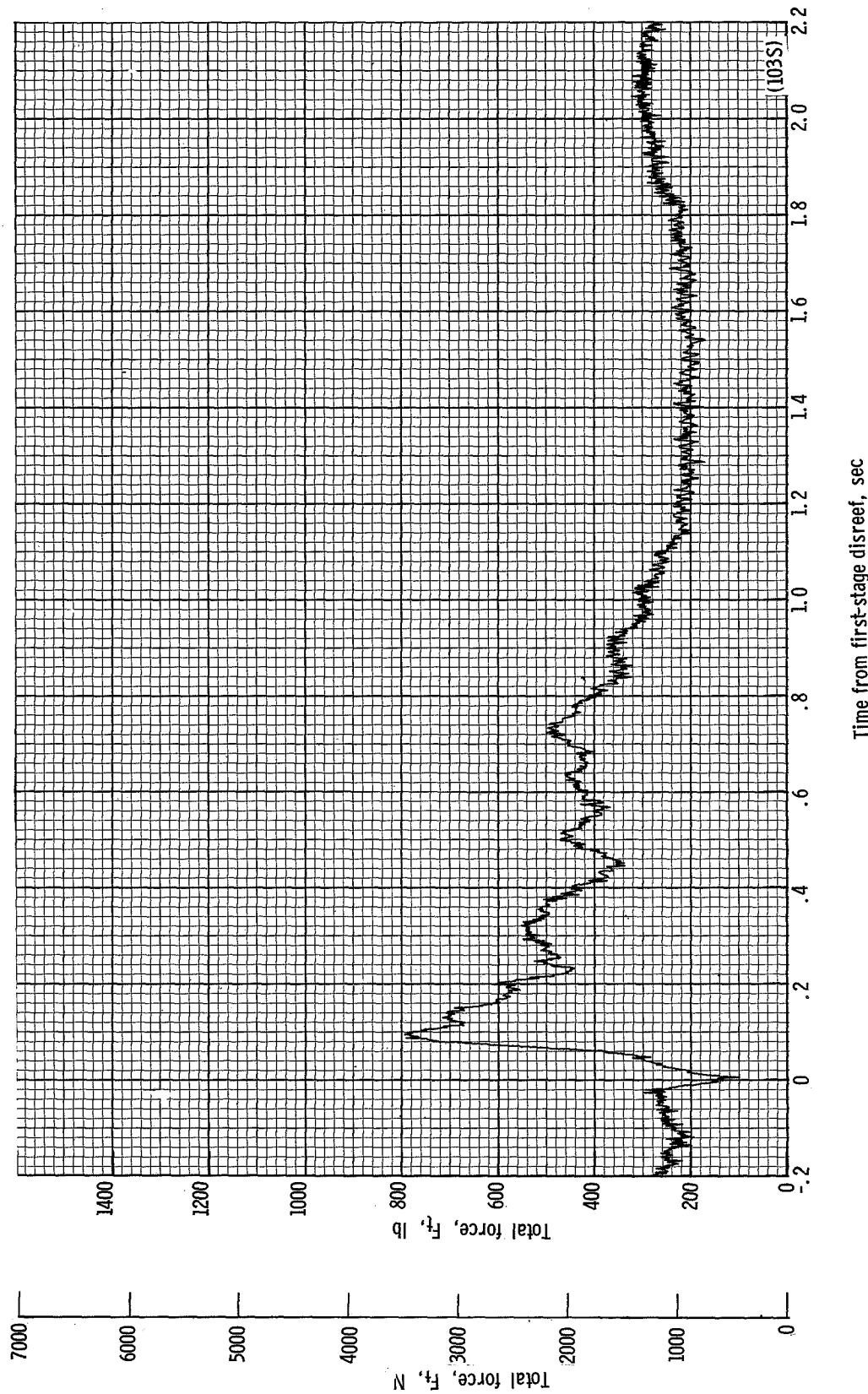
Figure 17.- Continued.



Time from first-stage disreef, sec

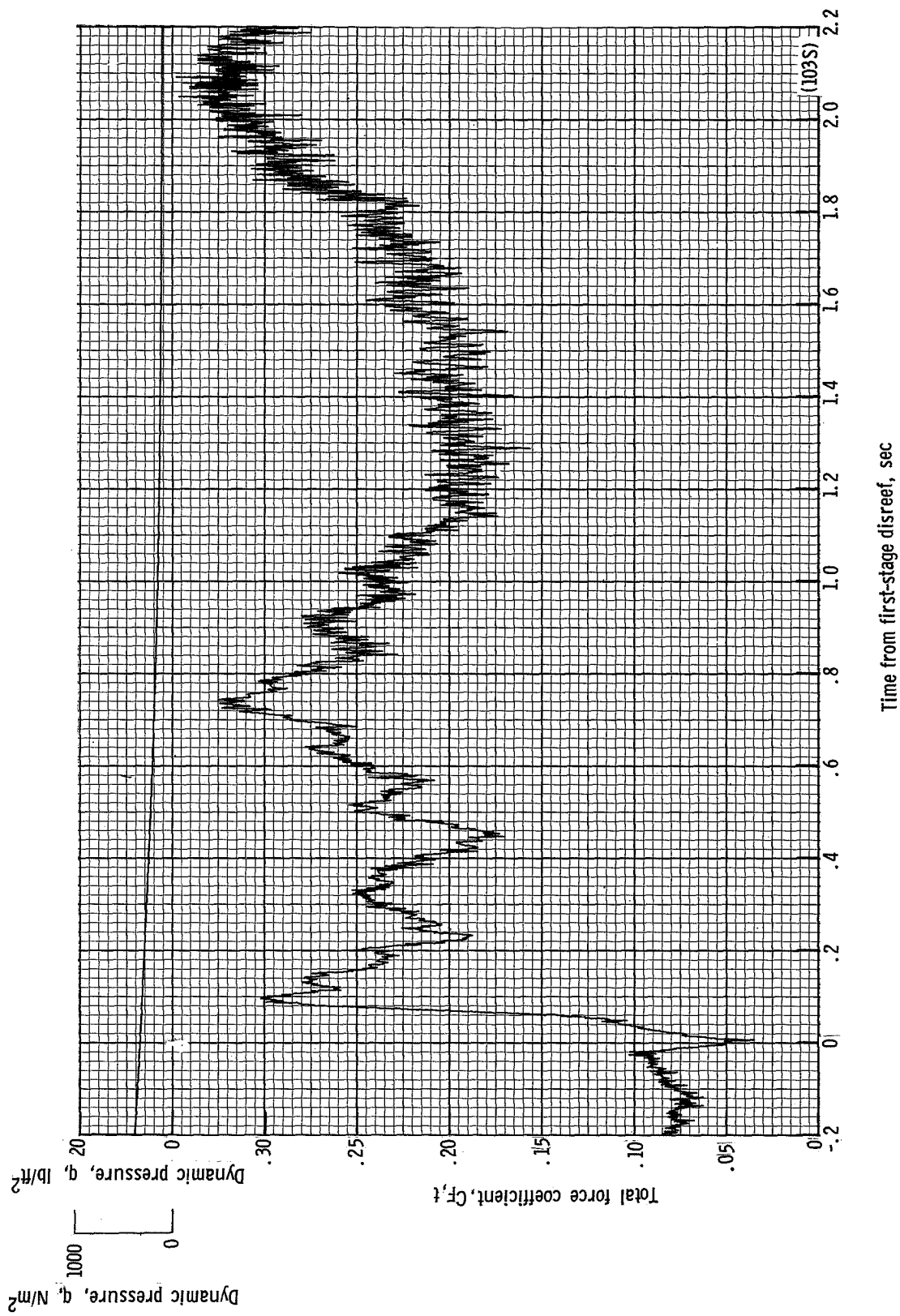
(h) Individual reefing-line loads, F_{2r} and F_{1r} , and acceleration a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 27.47 seconds after launch.

Figure 17.- Continued.



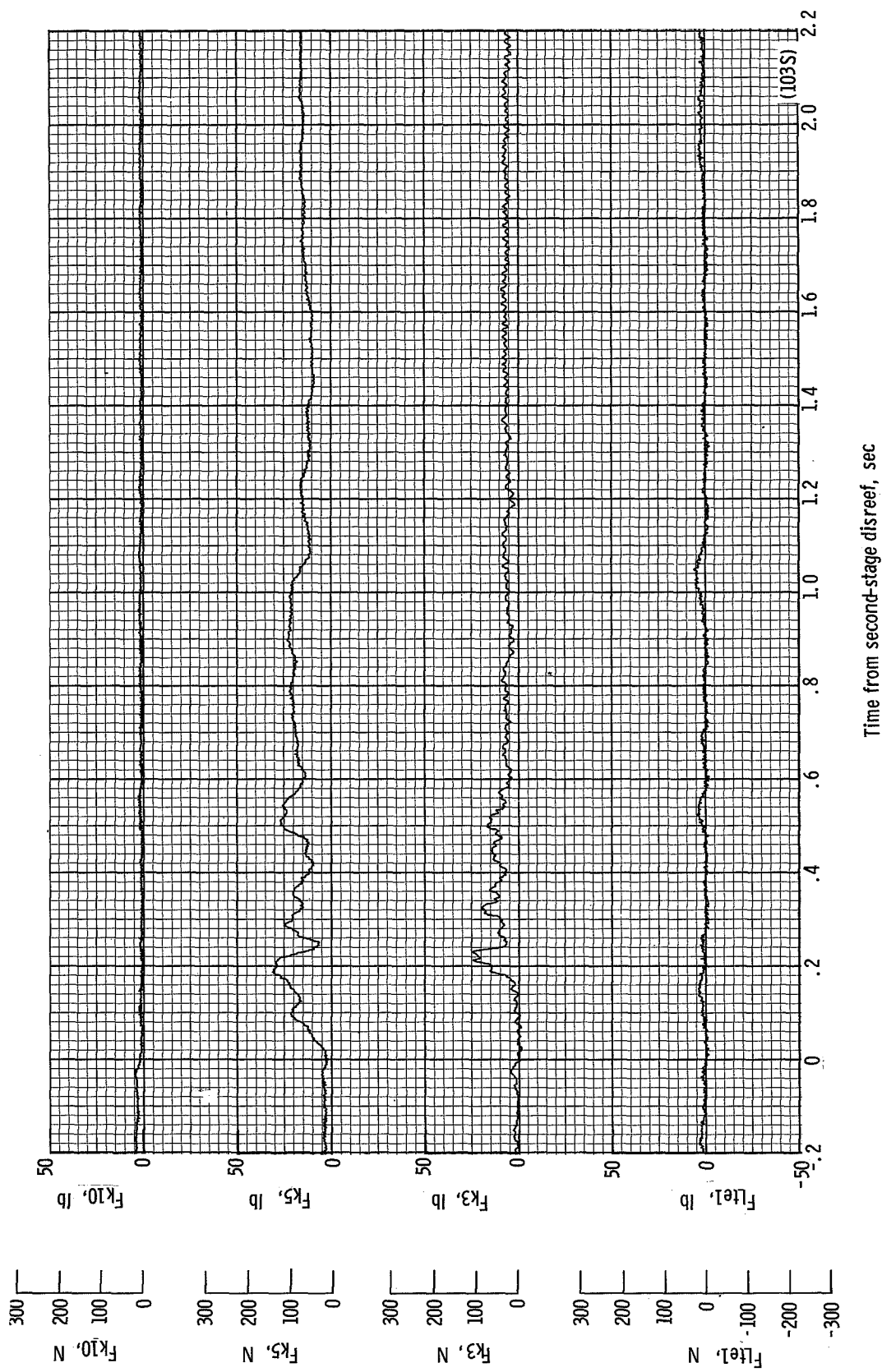
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 27.47 seconds after launch.

Figure 17.- Continued.



(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 27.47 seconds after launch.

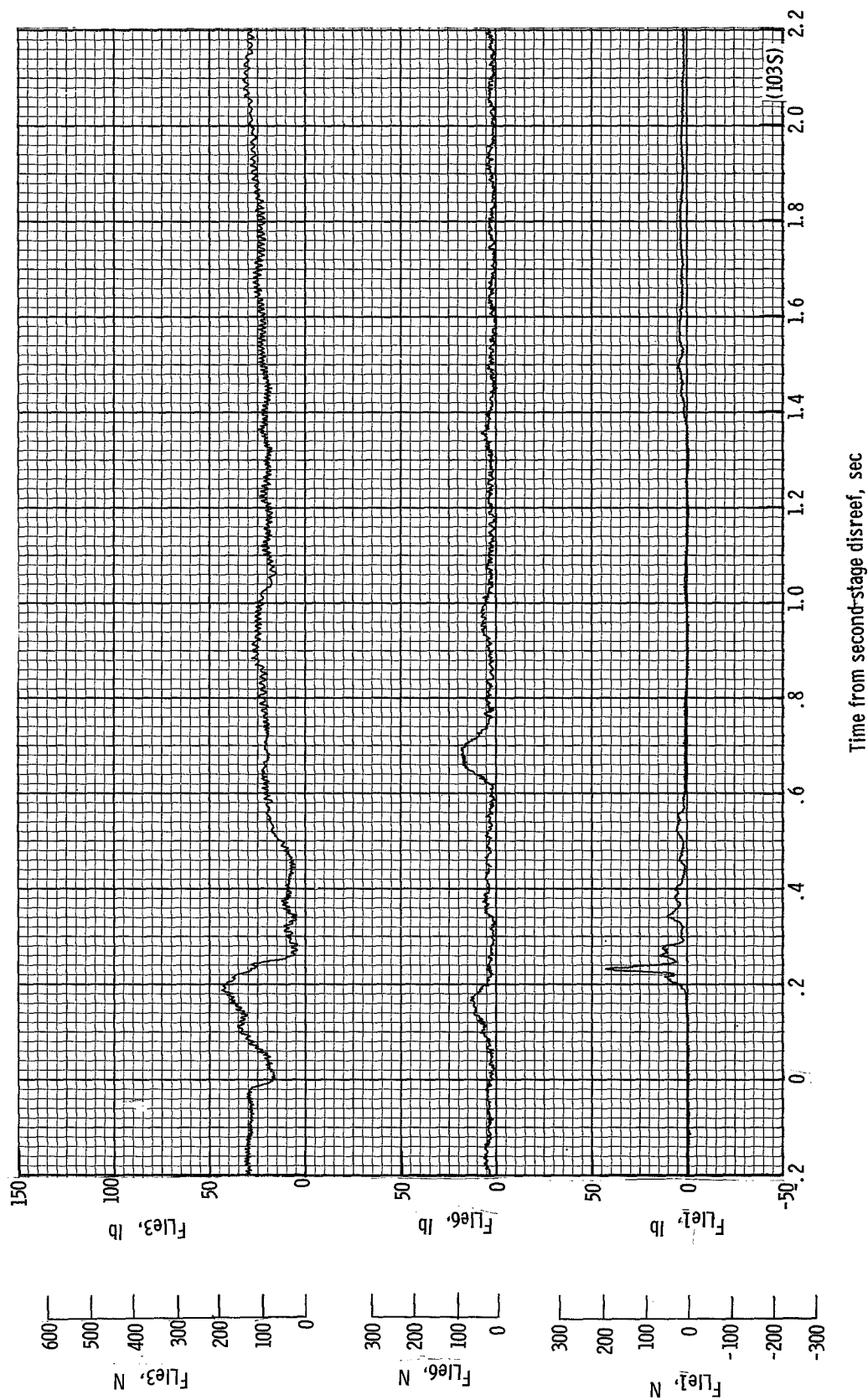
Figure 17.- Continued.



Time from second-stage disreef, sec

(k) Individual suspension-line loads F_{tet} , F_{k3} , F_{k5} , and F_{k10} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.34 seconds after launch.

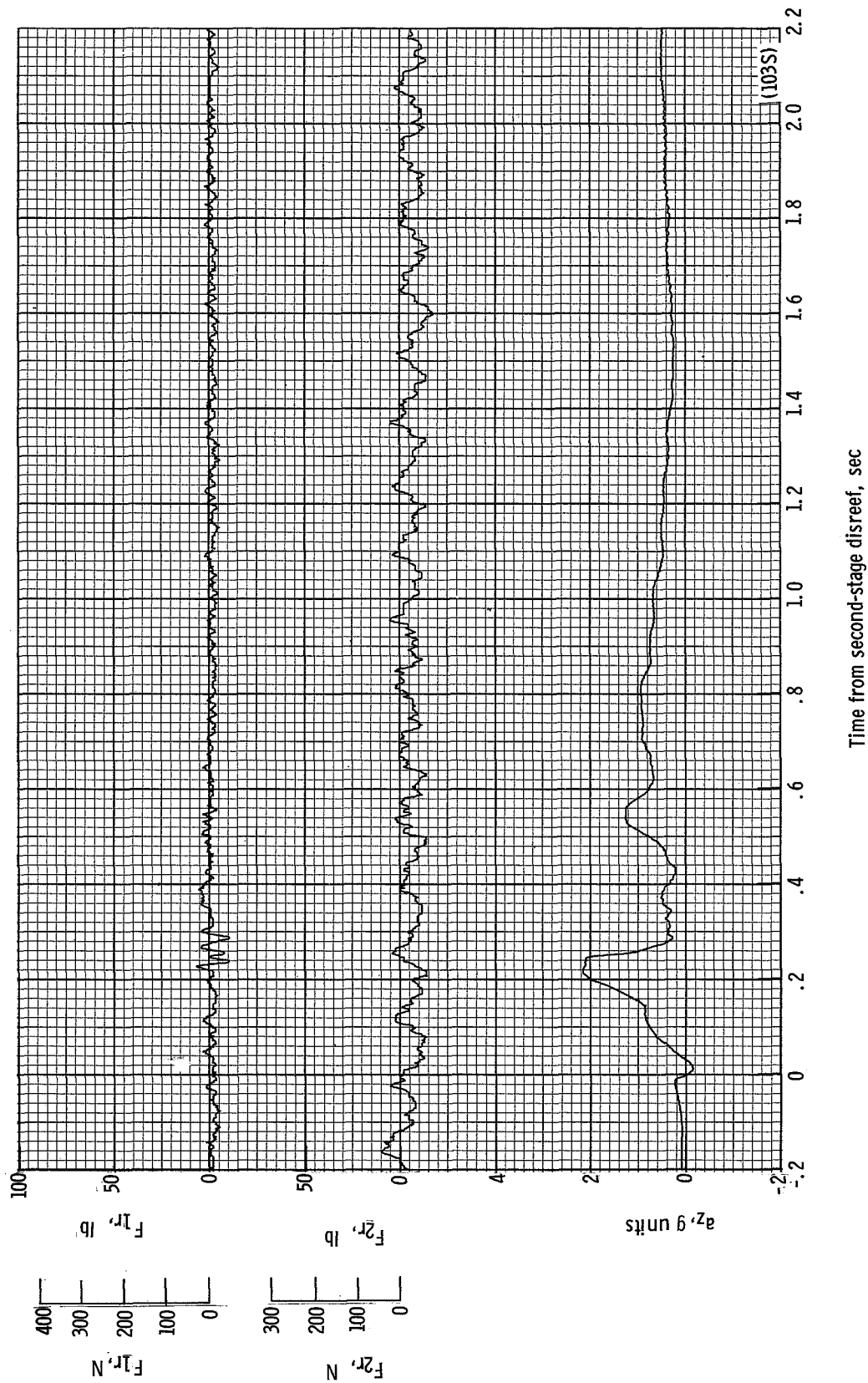
Figure 17.- Continued.



Time from second-stage disreef, sec

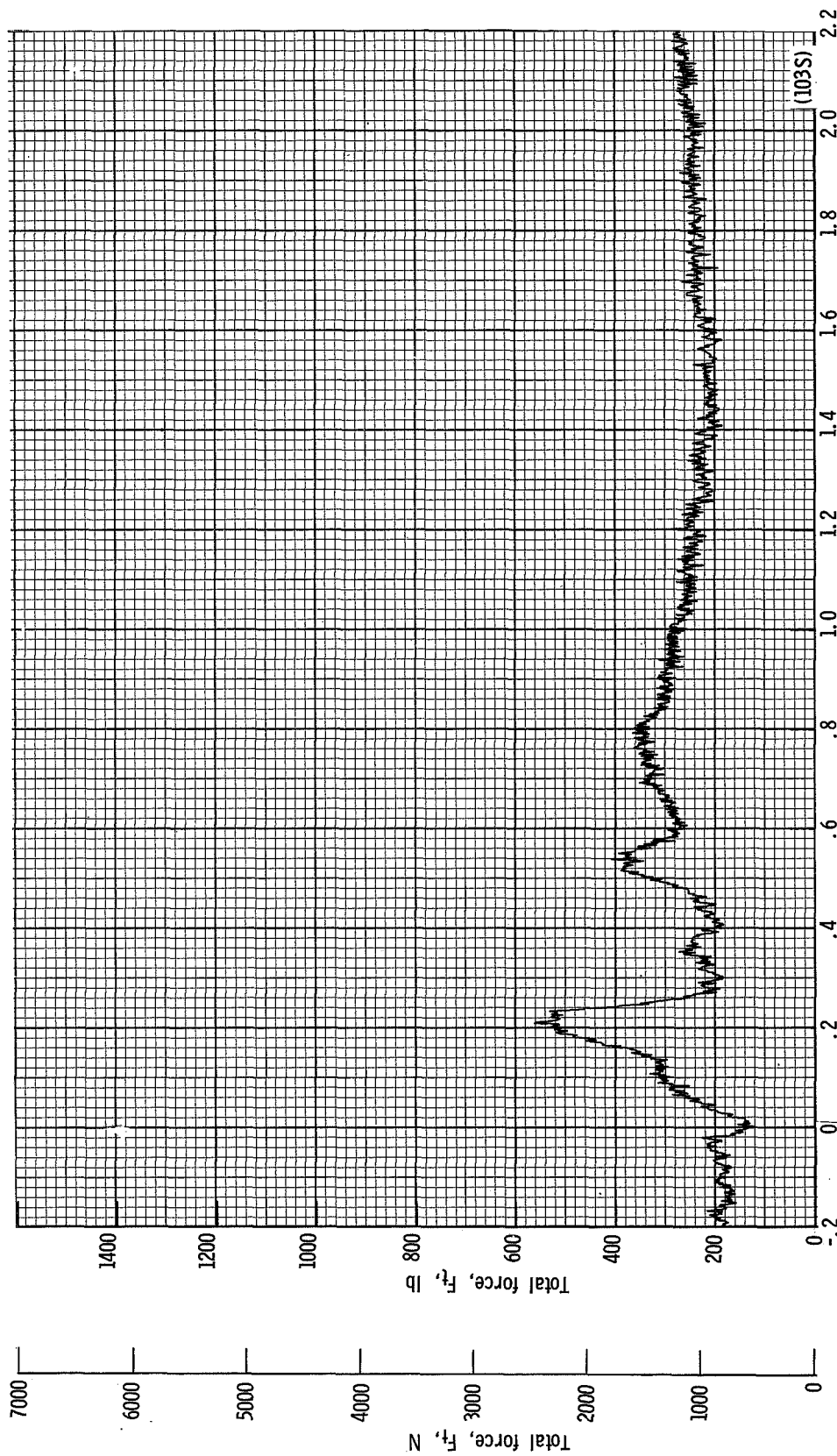
(1) Individual suspension-line loads F_{Lie1} , F_{Lie6} and F_{Lie3} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.34 seconds after launch.

Figure 17.- Continued.



(m) Individual reefing-line loads, F_{2r} , and F_{1r} , and acceleration a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 30.34 seconds after launch.

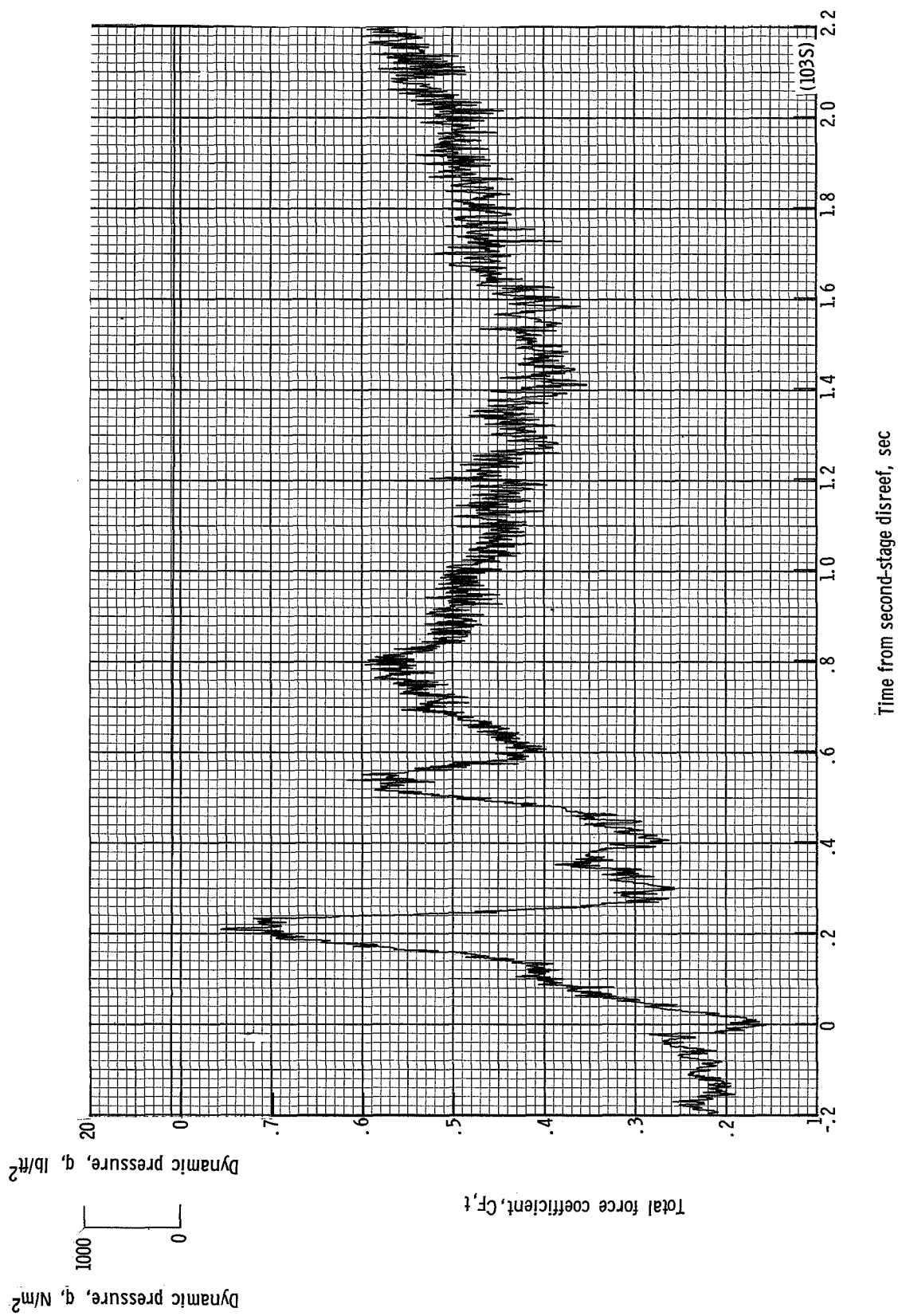
Figure 17.- Continued.



Time from second-stage disreef, sec

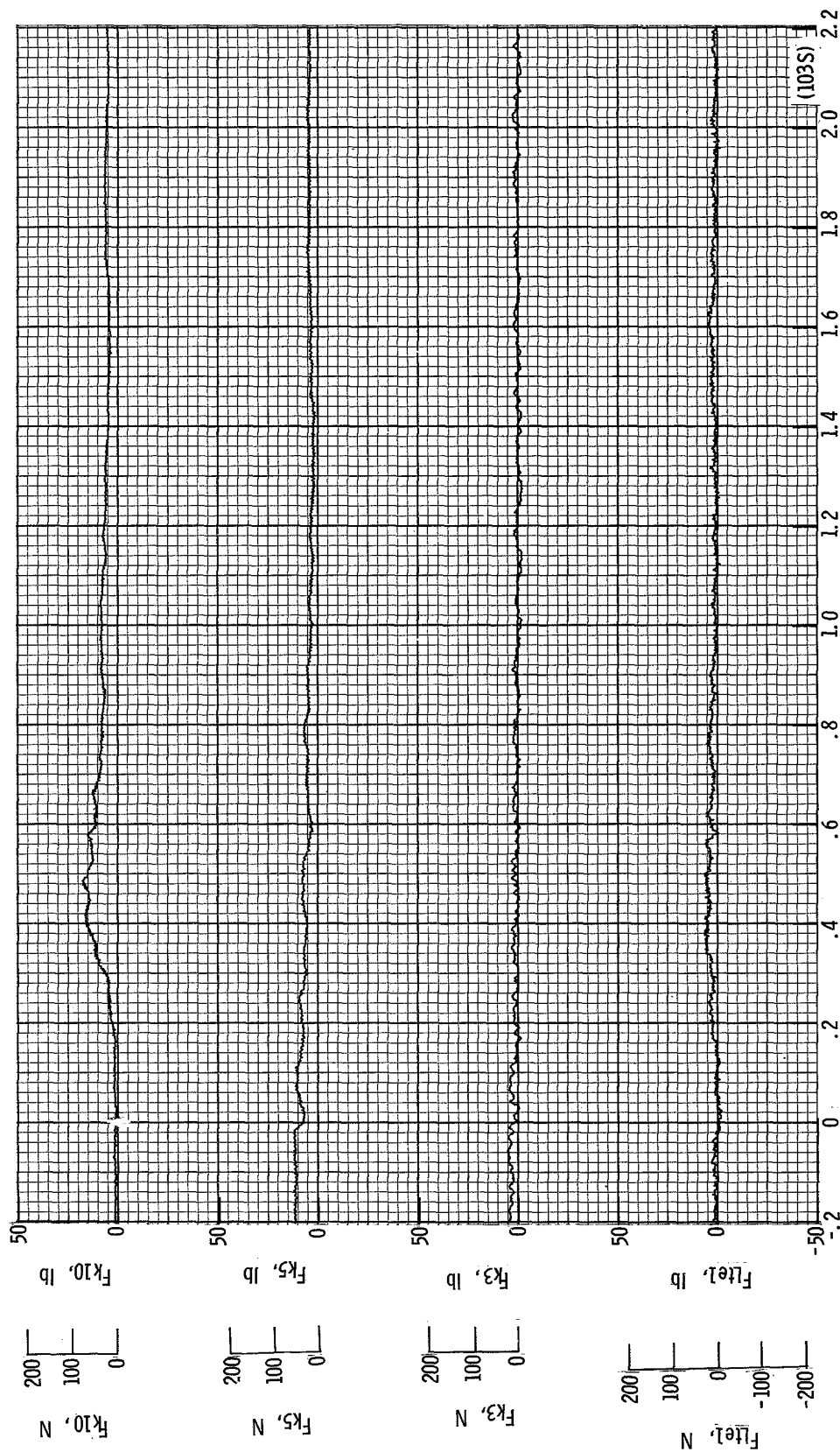
(n) Total force F_t plotted against time from second-stage disreef. Time \approx 0 second corresponds to 30.34 seconds after launch.

Figure 17.- Continued.



(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 30.34 seconds after launch.

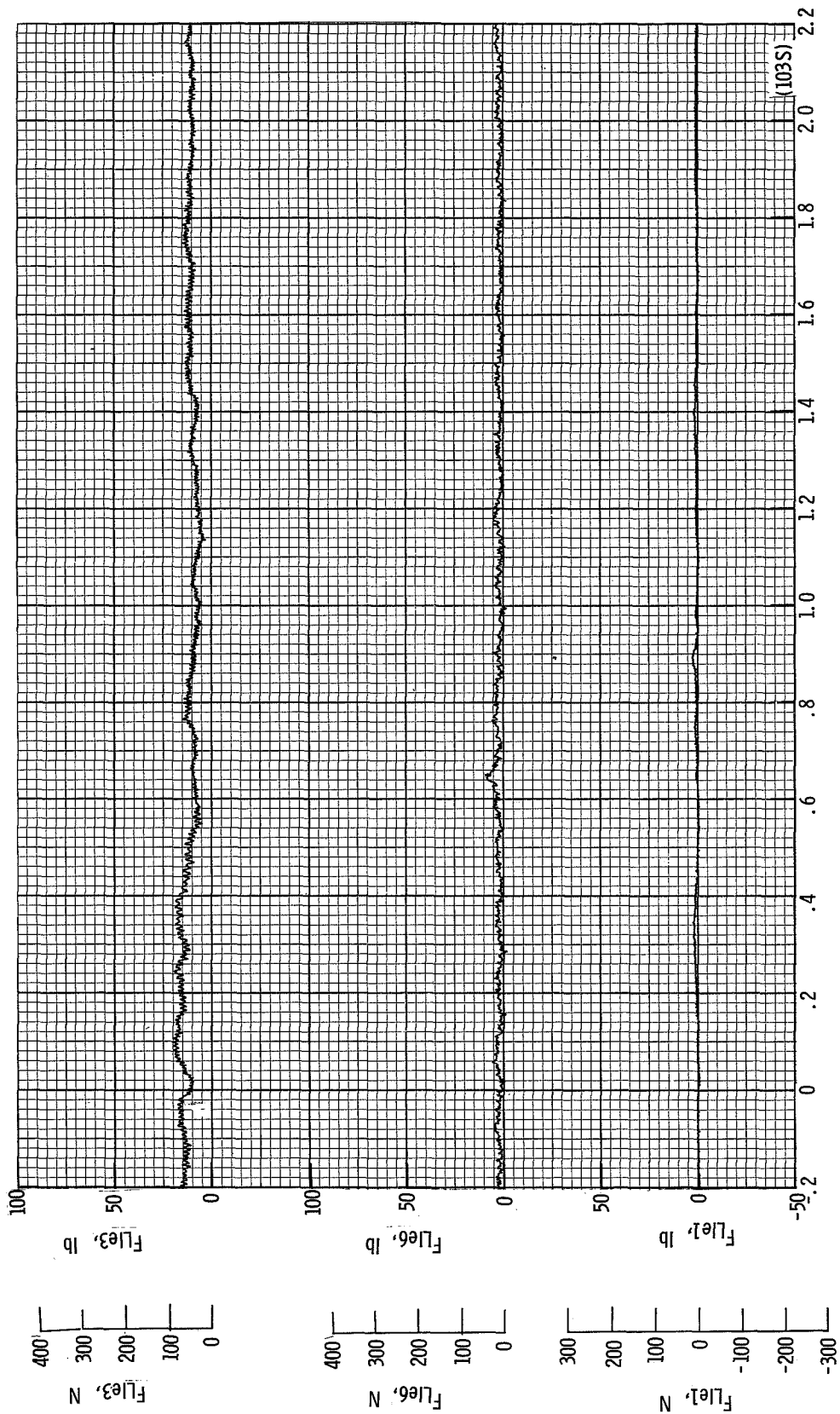
Figure 17.- Continued.



Time from third-stage disreef, sec

(p) Individual suspension-line loads F_{tle1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from third-stage disreef. Time ≈ 0 second corresponds to 34.29 seconds after launch.

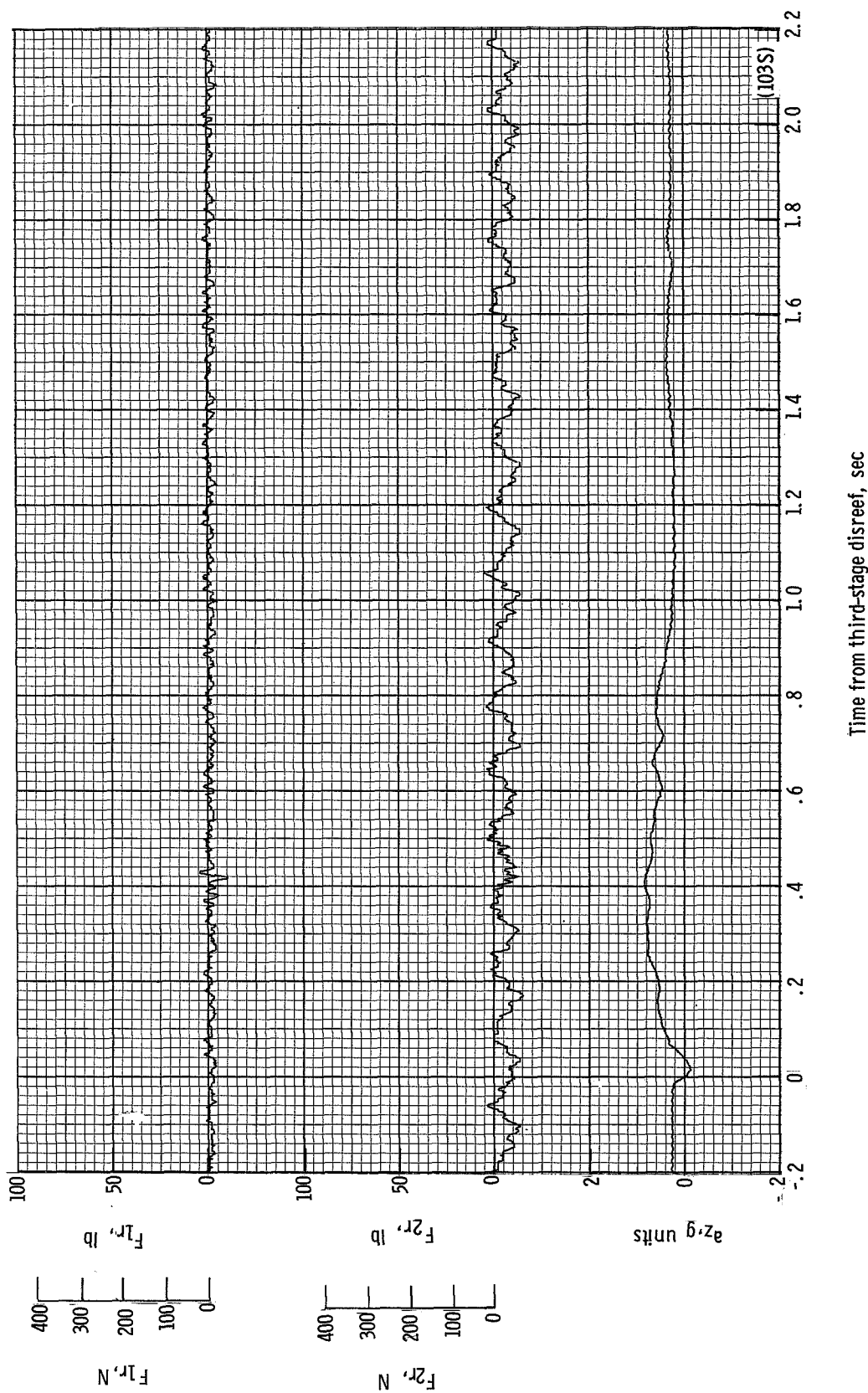
Figure 17.- Continued.



Time from third stage disreef, sec

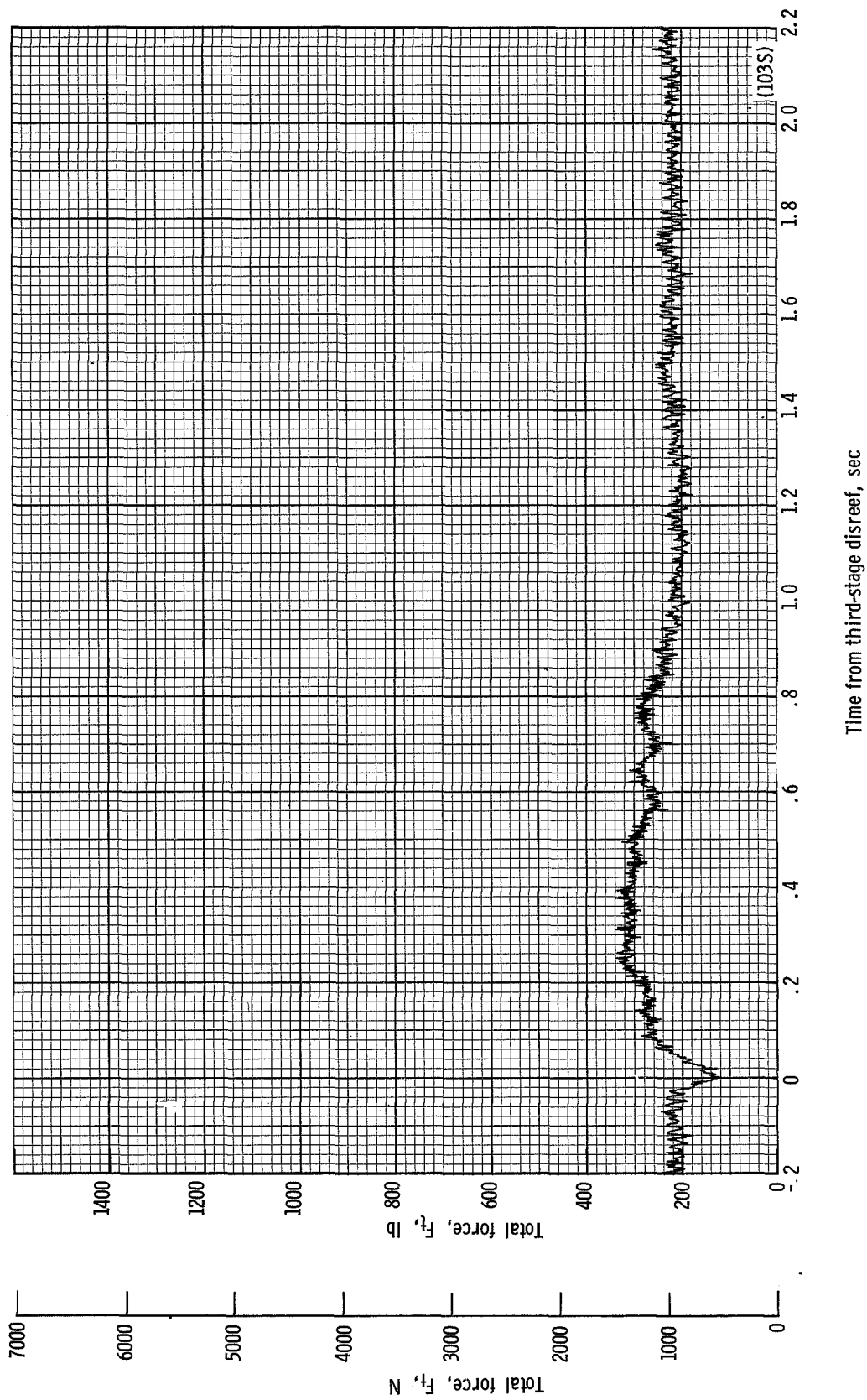
(q) Individual suspension-line loads F_{Lle1} , F_{Lle6} , and F_{Lle3} plotted against time from third-stage disreef. Time = 0 second corresponds to 34.29 seconds after launch.

Figure 17.- Continued.



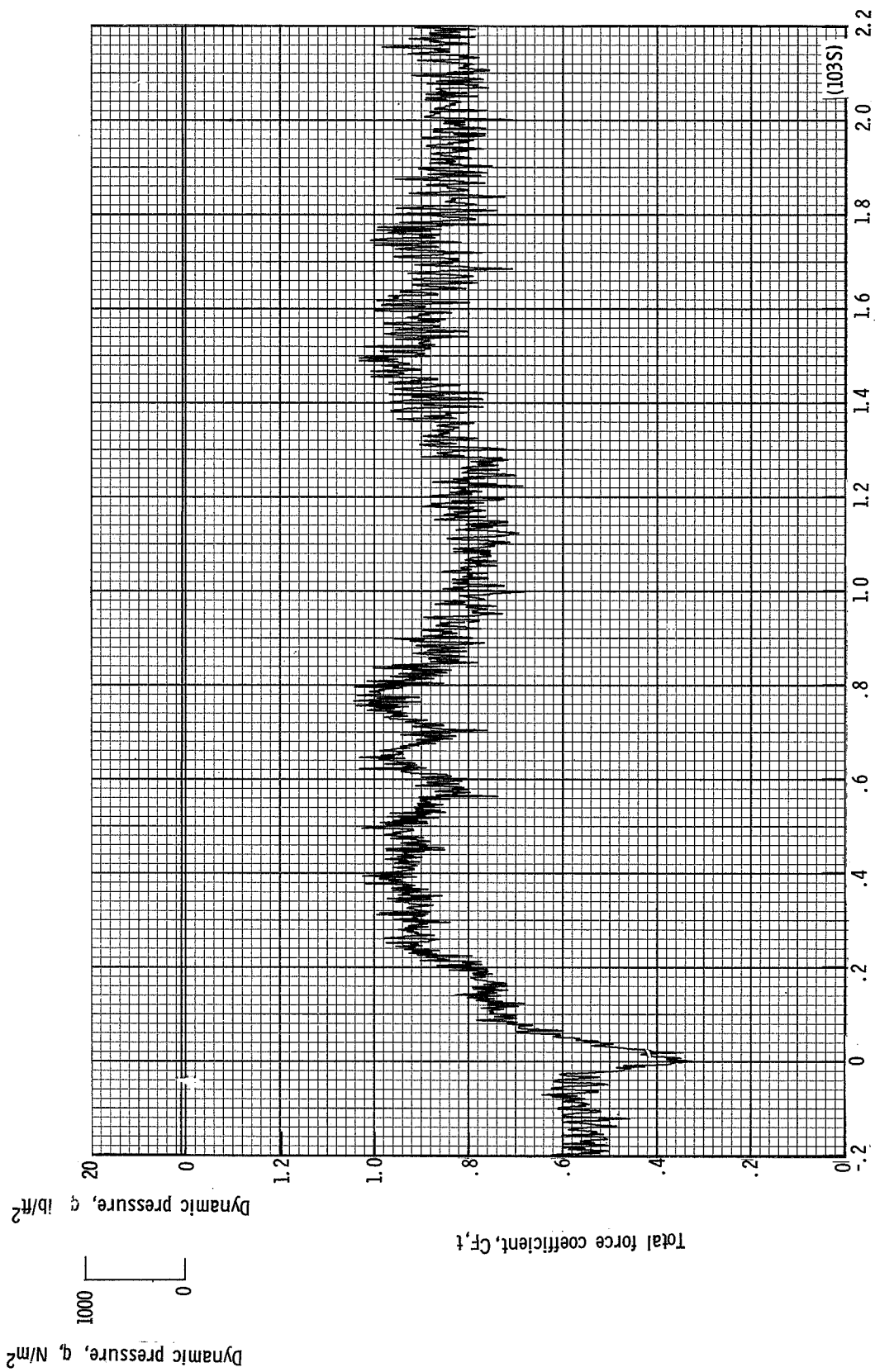
(r) Individual reefing-line loads, F_{2r} and F_{1r} , and acceleration a_z plotted against time from third-stage disreef. Time = 0 corresponds to 34.29 seconds after launch.

Figure 17.- Continued.



(s) Total force, F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 34.29 seconds after launch.

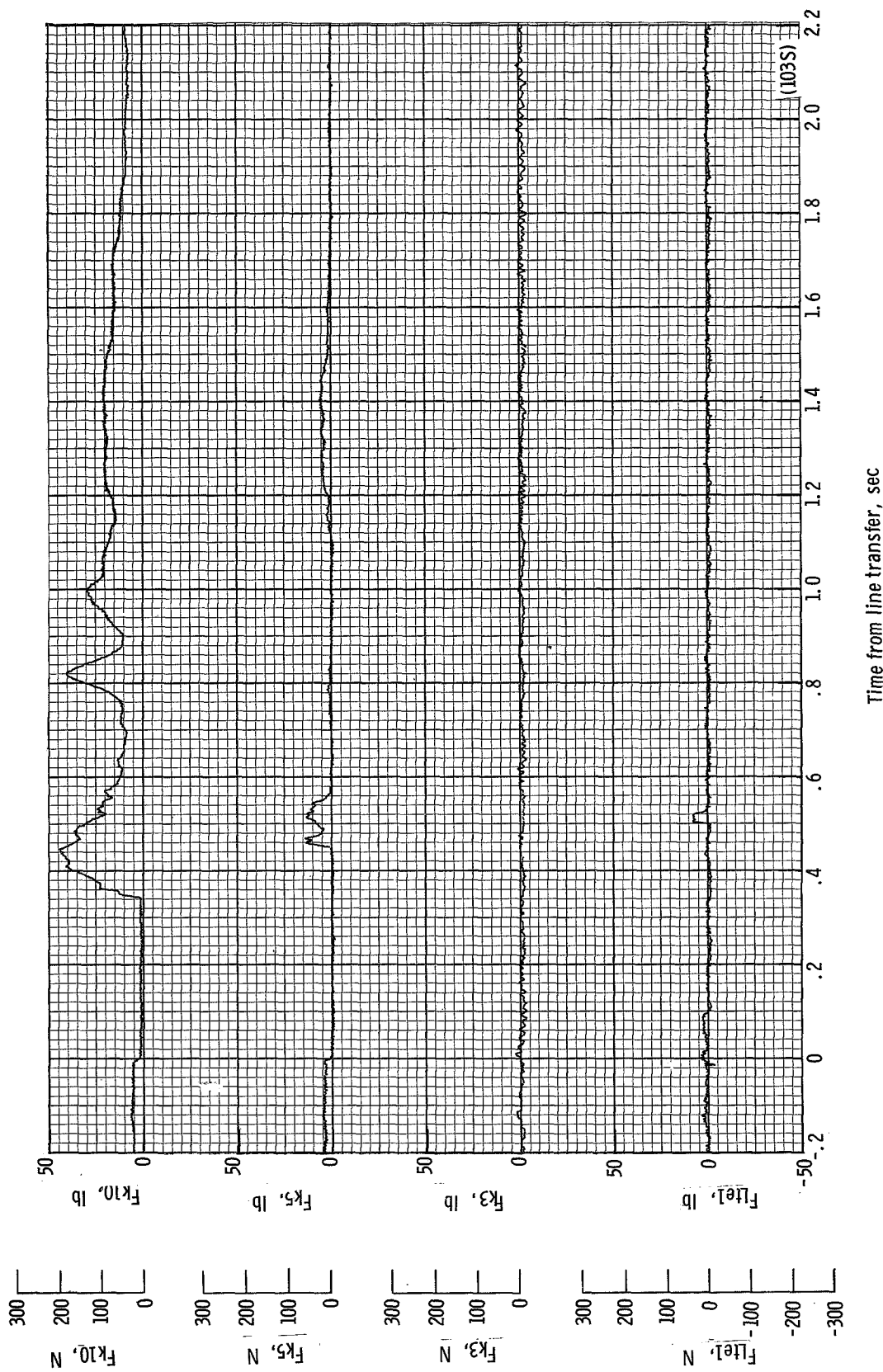
Figure 17.- Continued.



Time from third-stage disreef, sec

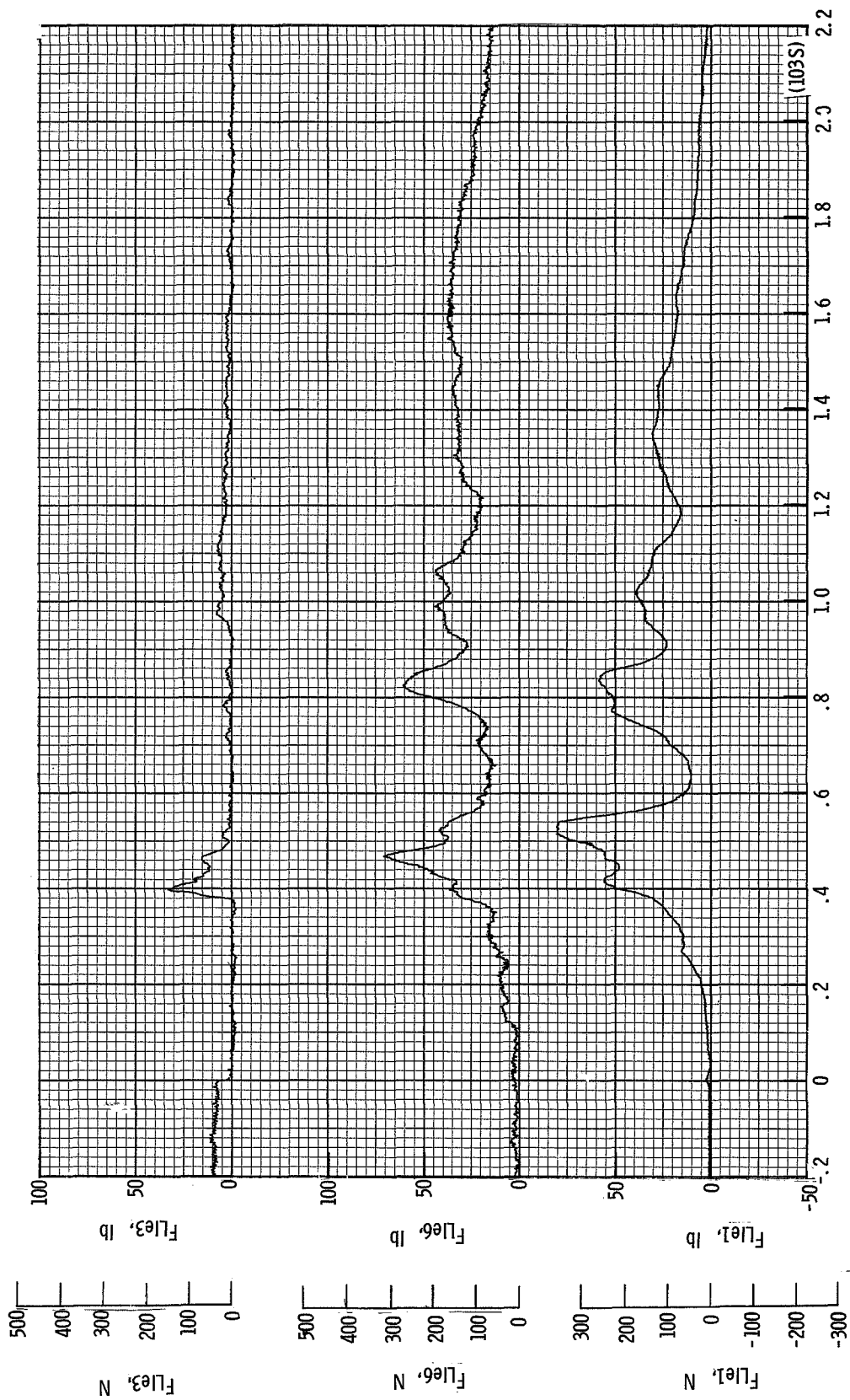
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 34.29 seconds after launch.

Figure 17.- Continued.



(u) Individual suspension-line loads F_{1e1} , F_{k3} , F_{k5} , and F_{k10} against time from line transfer. Time = 0 second corresponds to 36.71 seconds after launch.

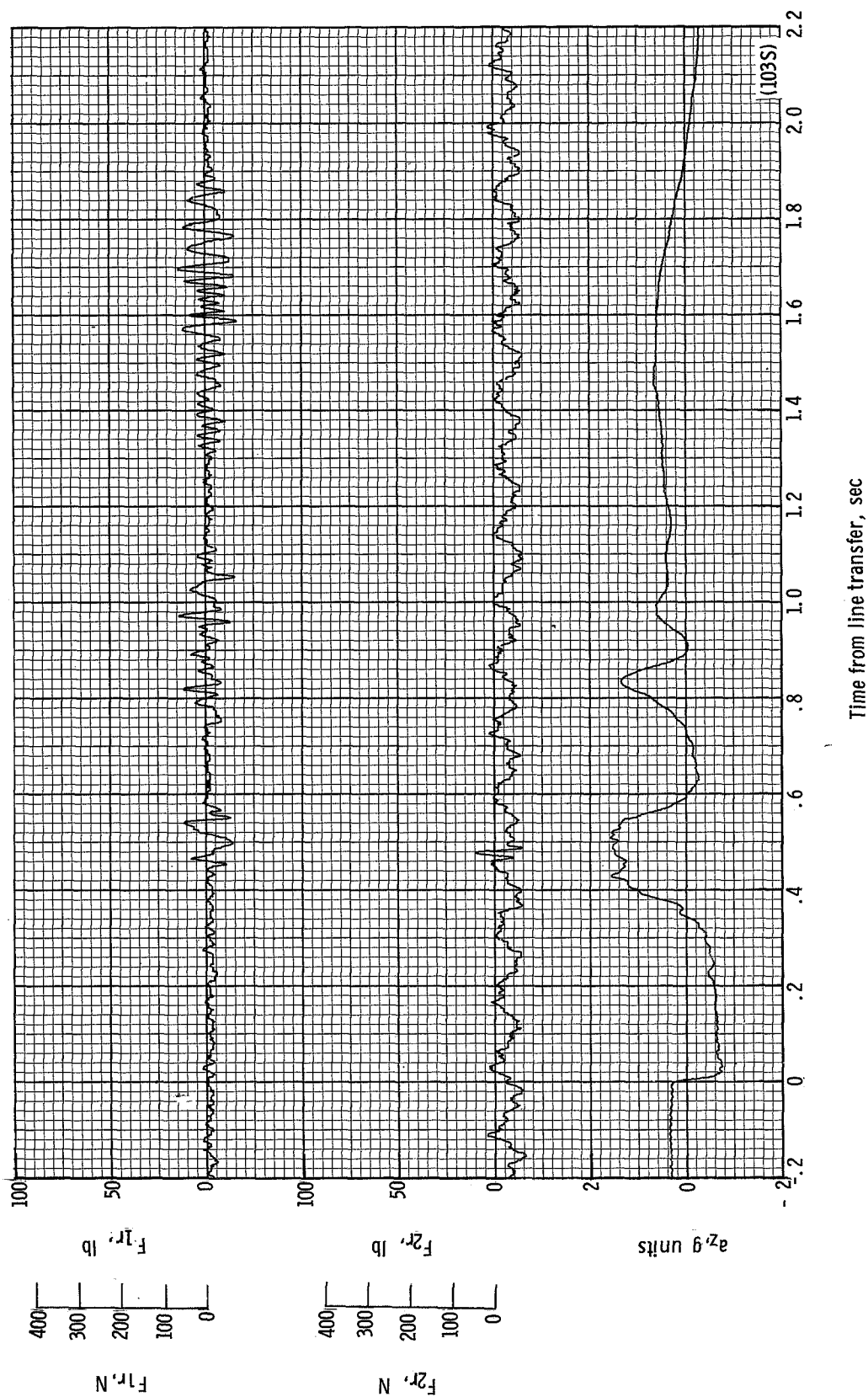
Figure 17.- Continued.



Time from line transfer, sec

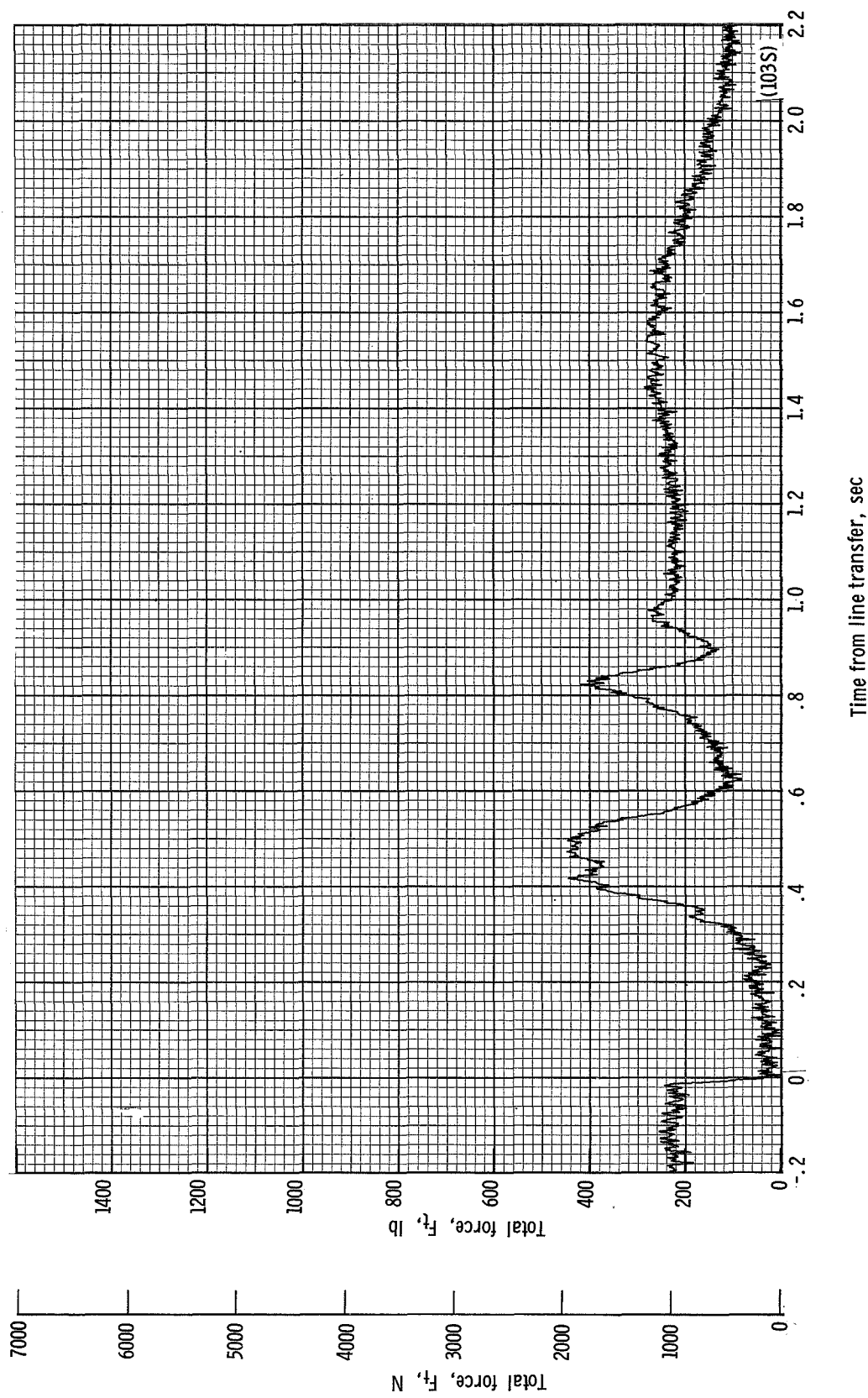
(v) Individual suspension-line loads F_{L1e1} , F_{L1e6} and F_{L1e3} plotted against time from line transfer. Time = 0 second corresponds to 36.71 seconds after launch.

Figure 17.- Continued.



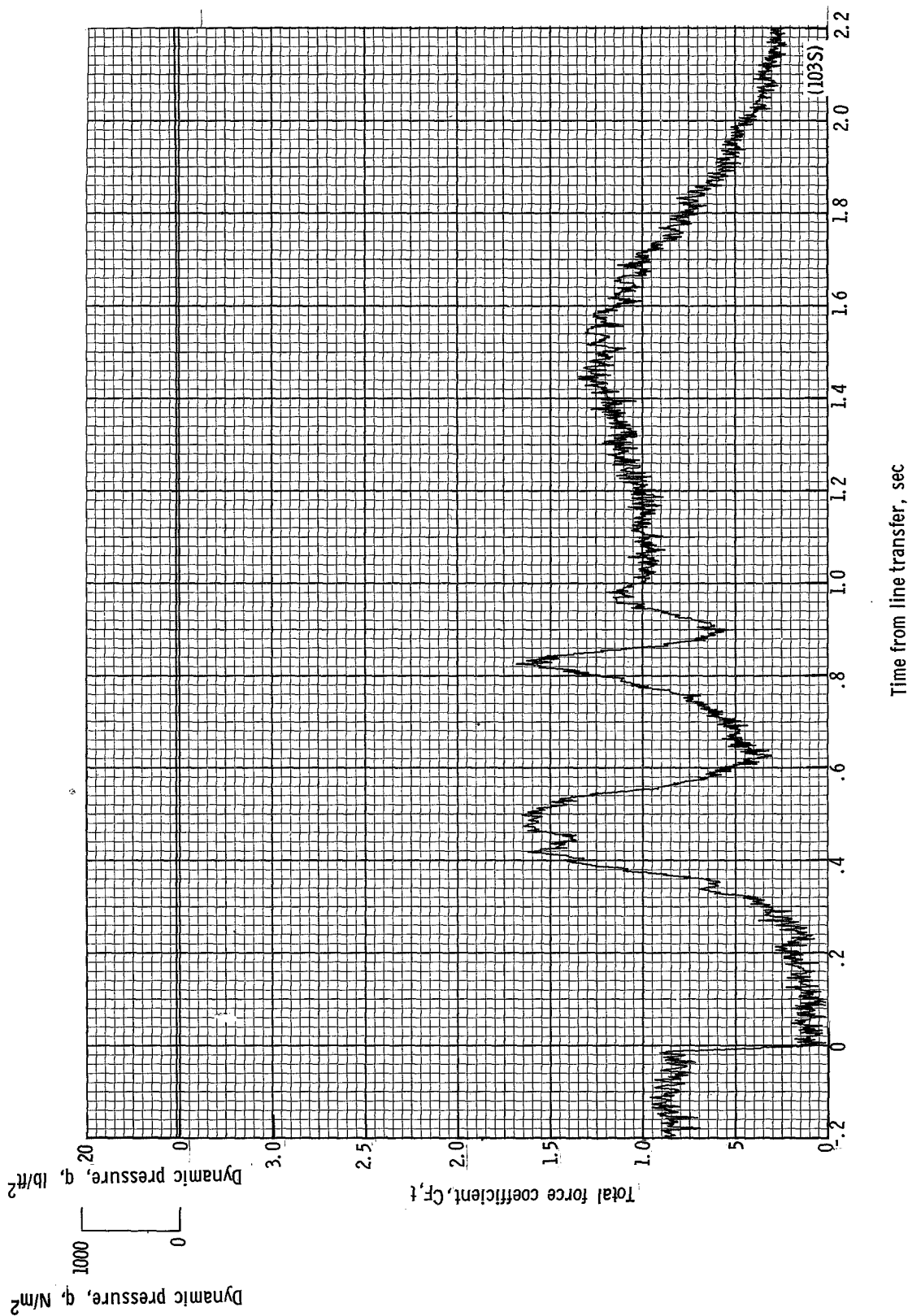
(w) Individual reefing-line loads, F_{2r} and F_{1r} , and acceleration a_z plotted against time from line transfer. Time = 0 second corresponds to 36.71 seconds after launch.

Figure 17.- Continued.



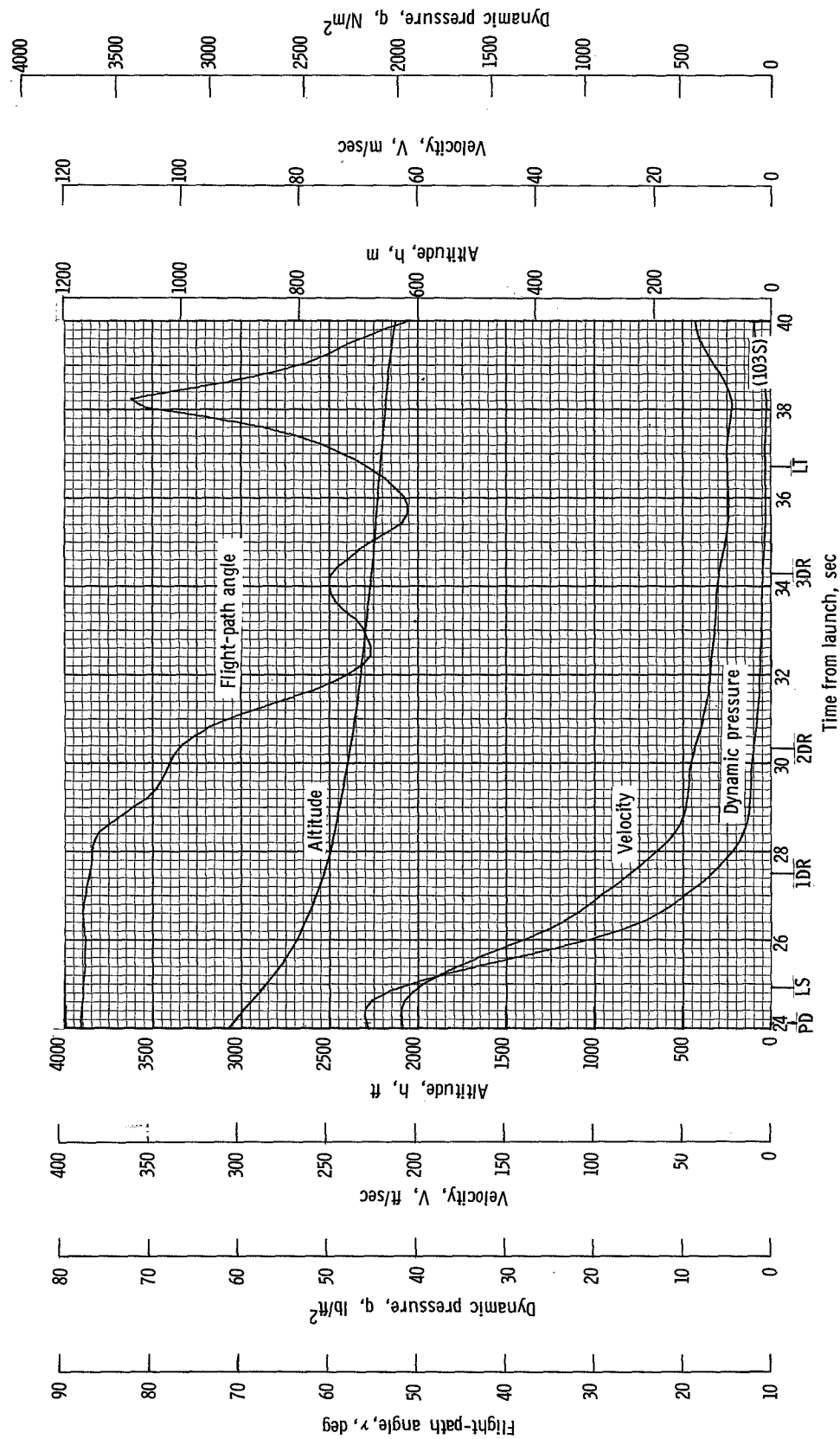
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 36.71 seconds after launch.

Figure 17.- Continued.



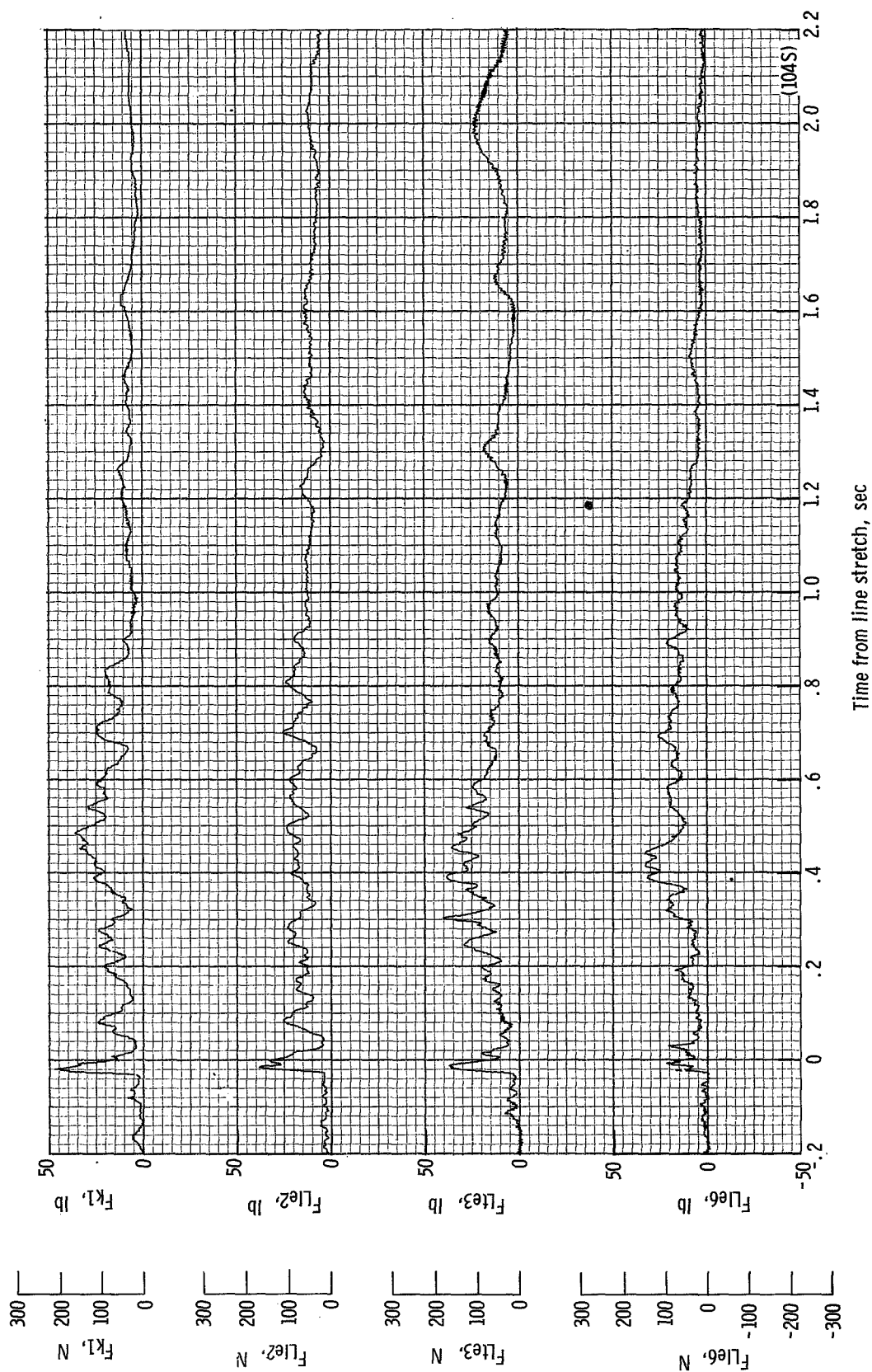
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 36.71 seconds after launch.

Figure 17.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

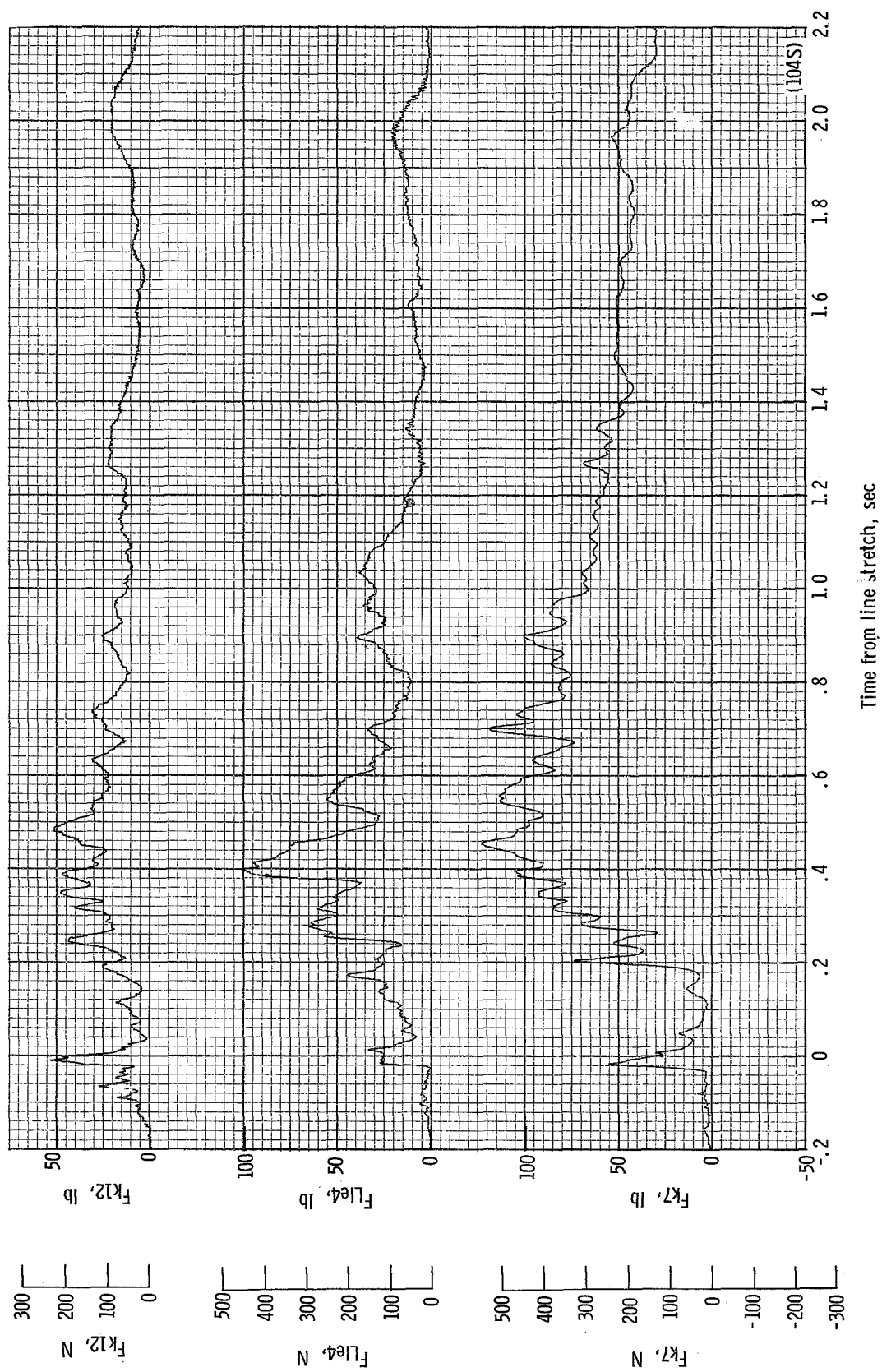
Figure 17. - Concluded.



(a) Individual suspension-line loads F_{L1e6} , F_{L1e3} , F_{L1e2} , and F_{K1} plotted against time from line stretch. Time = 0 second corresponds to 11.10 seconds after launch.

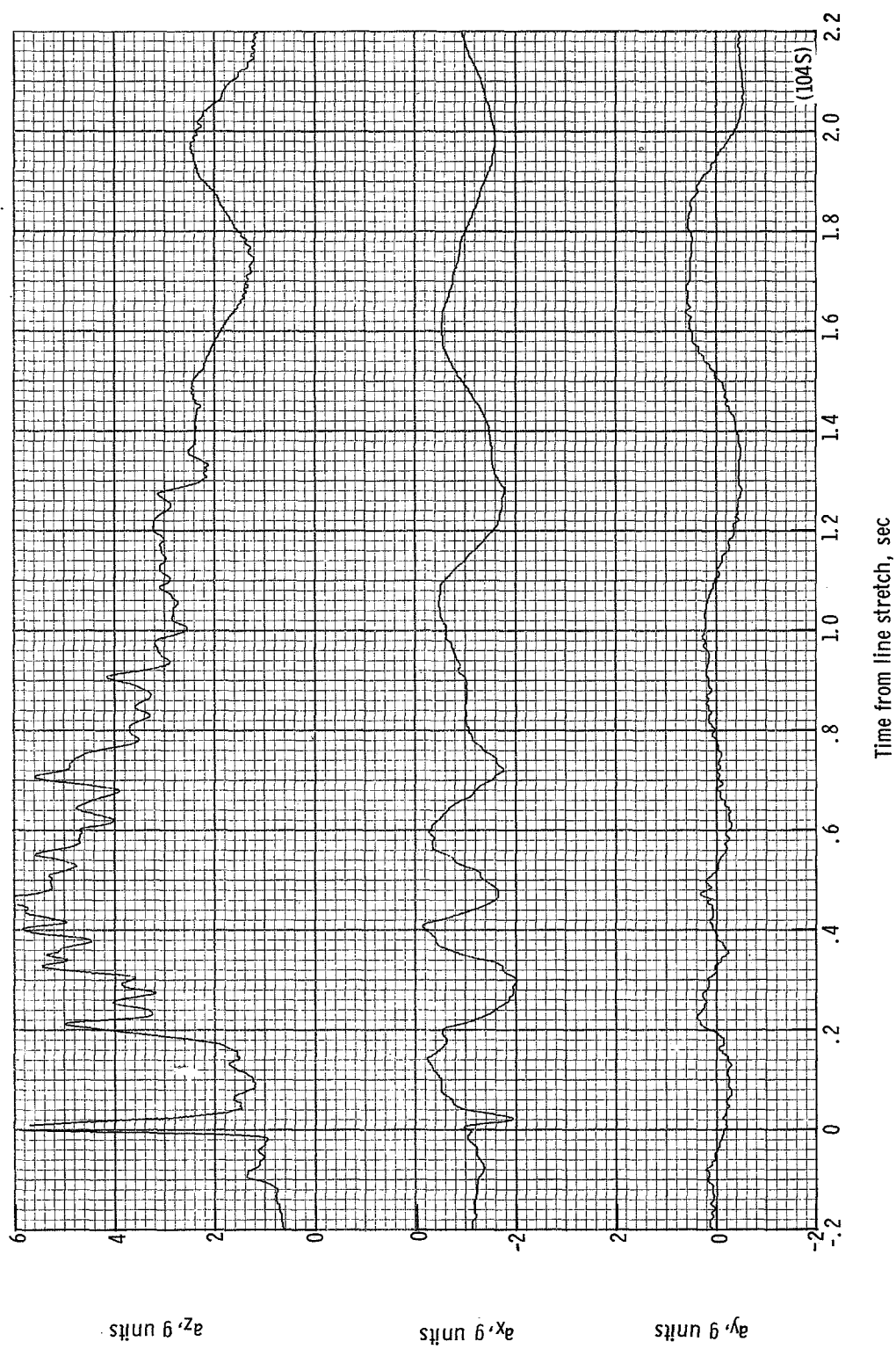
Figure 18.- Time history of single-keel parawing deployment data for test 104S. $W_D = 1124.5$ N (252.8 lb); $W_P = 983.1$ N (221.0 lb); $q_{PD} = 2355.7$ N/m² (49.2 lb/ft²);

$h_{PD} = 986$ m (3236 ft); $l_v/l_k = 0.201$; reeling version 1.



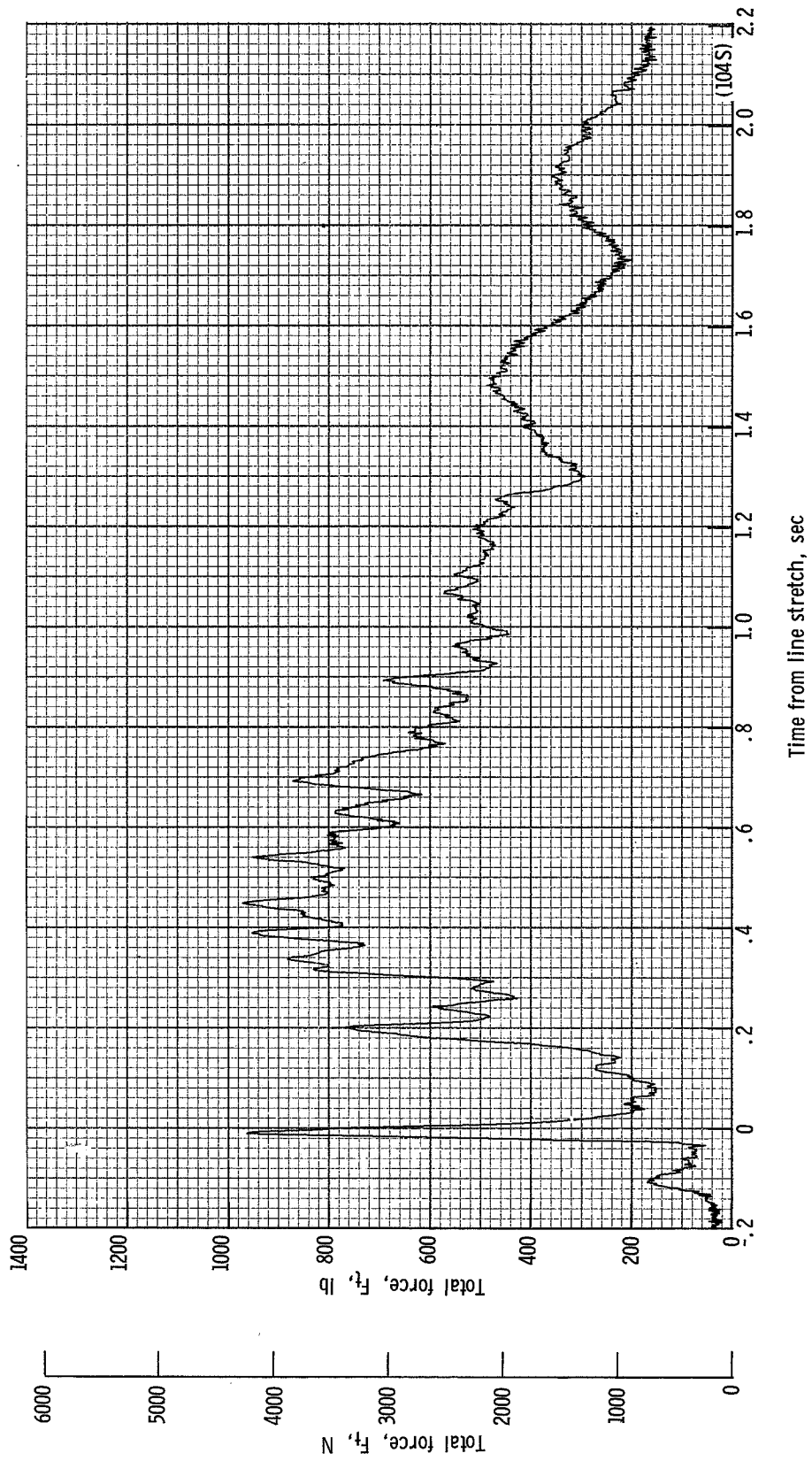
(b) Individual suspension-line loads F_{k7} , F_{Lle4} and F_{k12} plotted against time from line stretch. Time = 0 second corresponds to 11.10 seconds after launch.

Figure 18.- Continued.



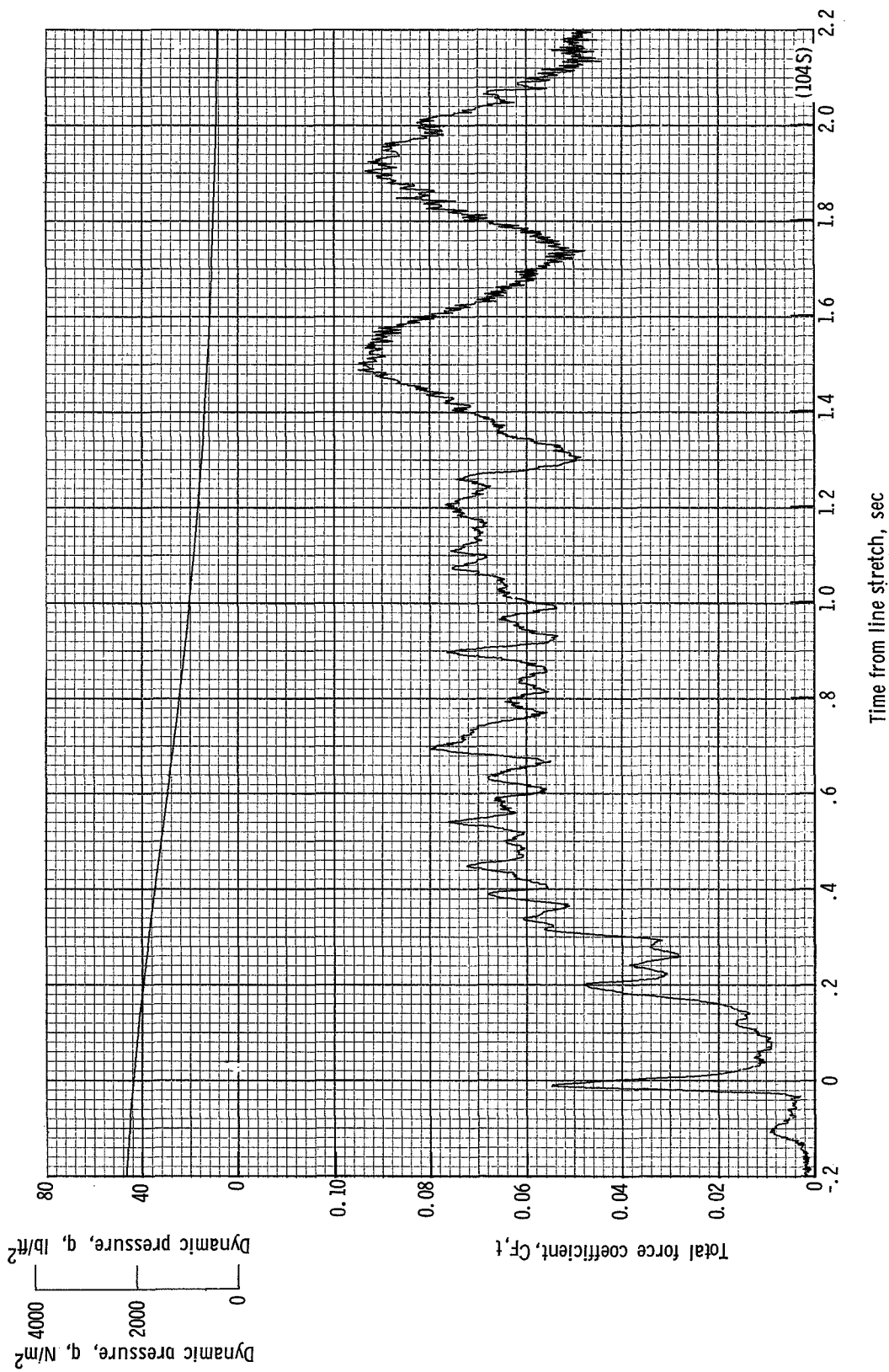
(c) Accelerations a_y , a_x , and a_z plotted against time from line stretch. Time = 0 second corresponds to 11.10 seconds after launch.

Figure 18.- Continued.



(d) Total force F_t time from line stretch. Time = 0 second corresponds to 11.10 seconds after launch.

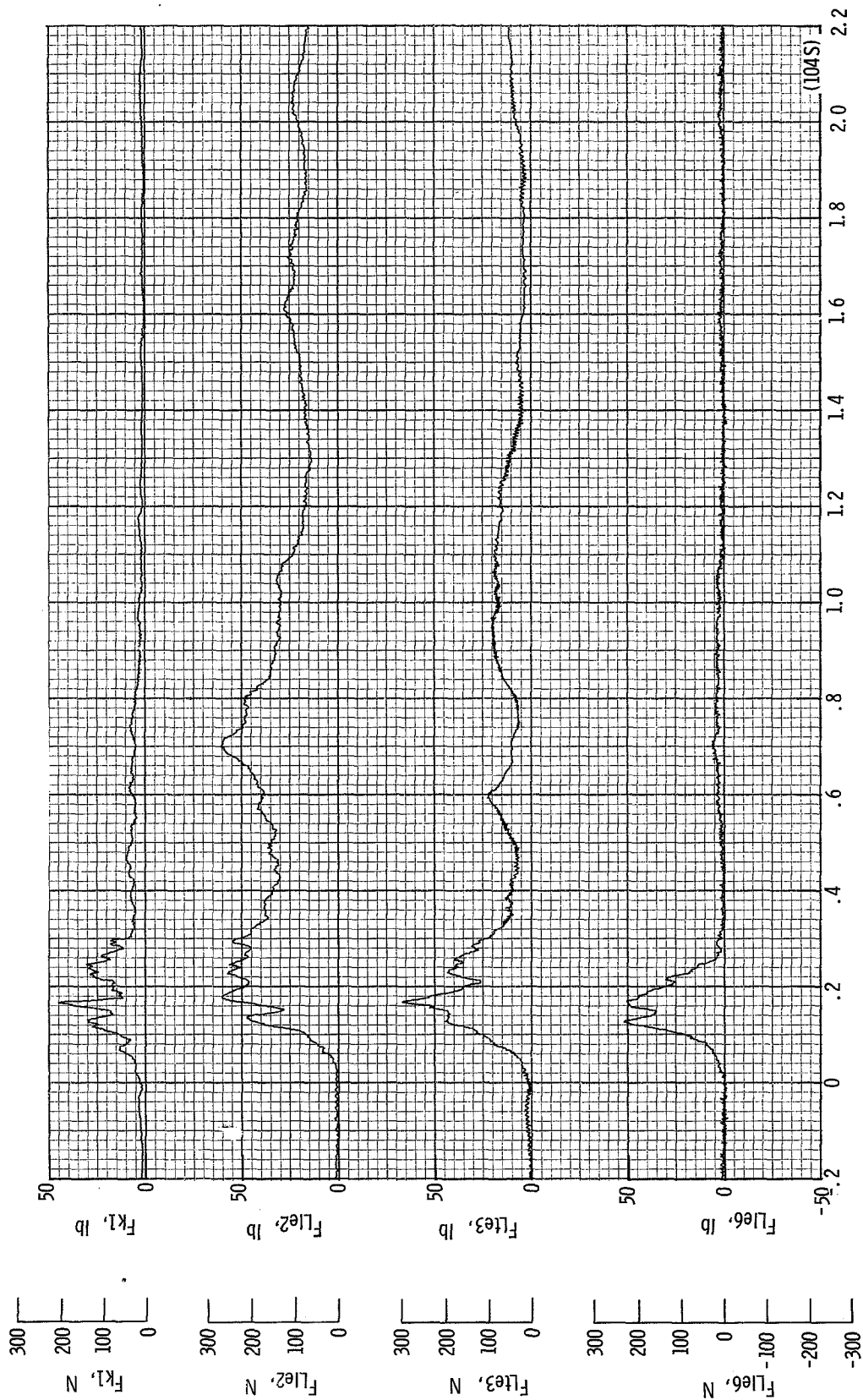
Figure 18.- Continued.



(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 11.10 seconds after launch.

Figure 18.- Continued.

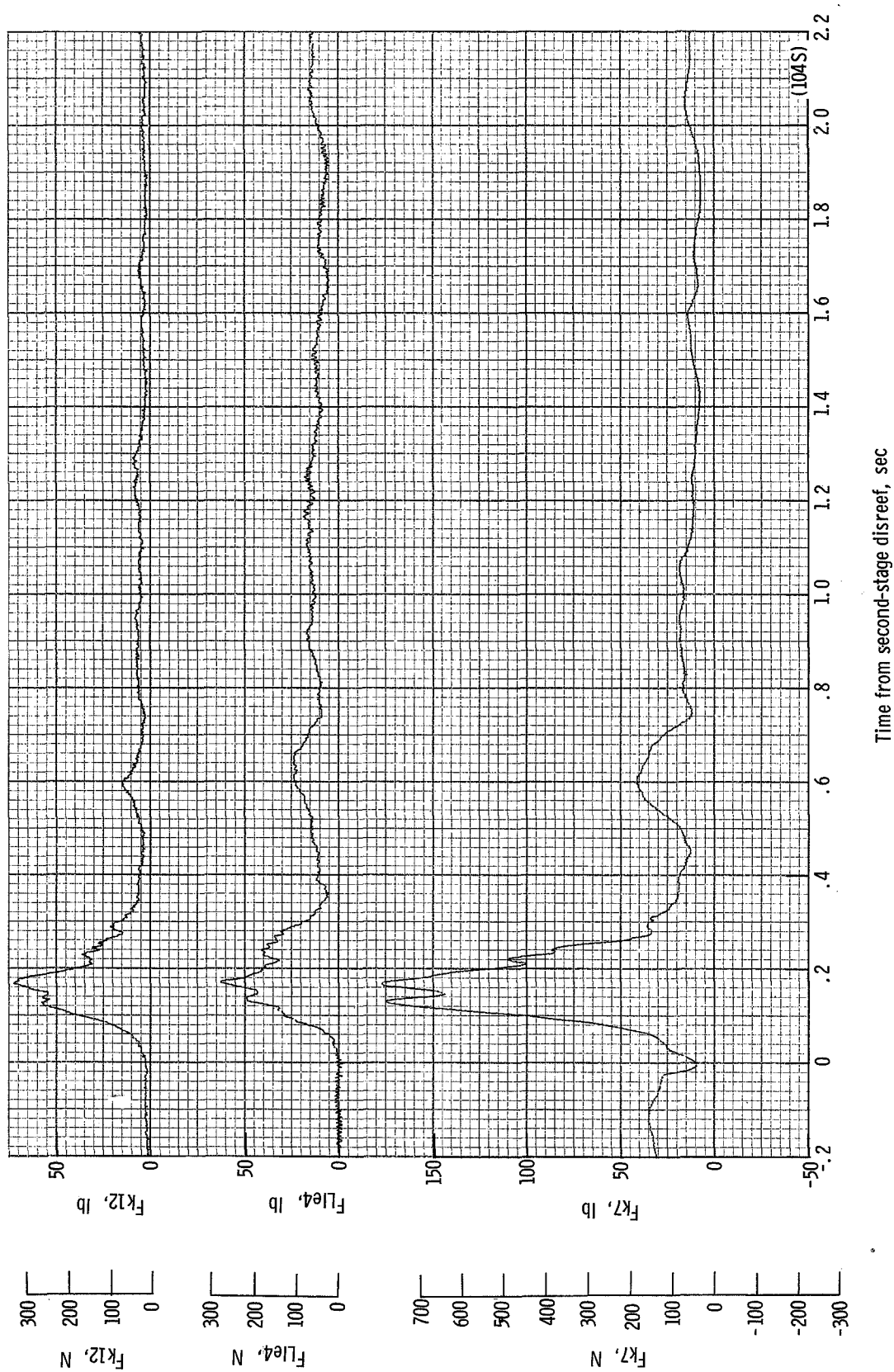
Figures 18(f), 18(g), 18(h), 18(i), and 18(j) were omitted; second-stage disreef did not occur because of a reefing line hang up. The wing went directly from the first-stage configuration to the third-stage configuration.



Time from second-stage disreef, sec

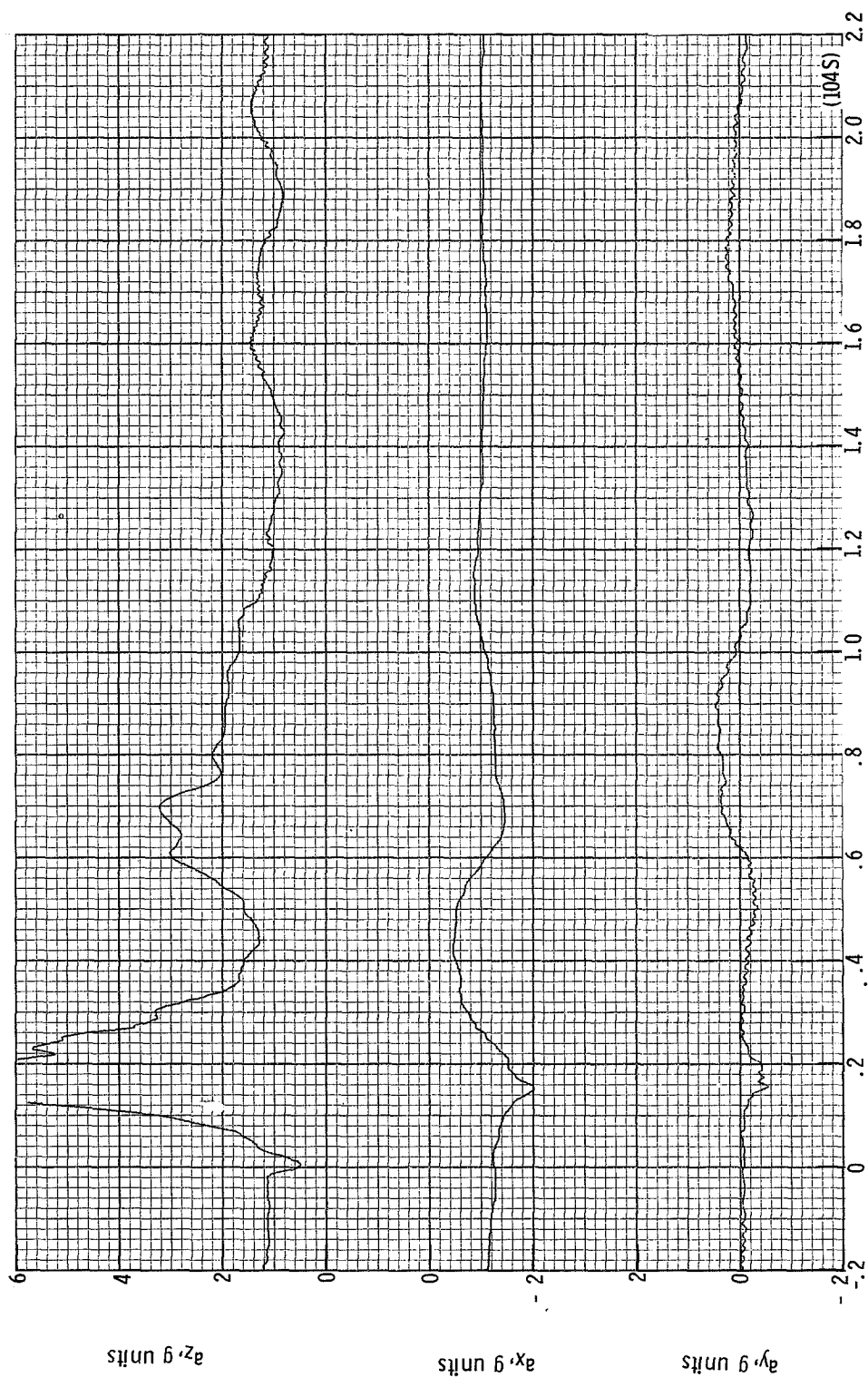
(k) Individual suspension-line loads F_{lie6} , F_{lie3} , F_{lie2} , and F_{k1} plotted against time from second-stage disreef. Time = 0 second corresponds to 16.45 seconds after launch.

Figure 18.- Continued.



(1) Individual suspension-line loads F_{k7} , F_{Lle4} , and F_{k12} plotted against time from second-stage disreef. Time = 0 second corresponds to 16.45 seconds after launch.

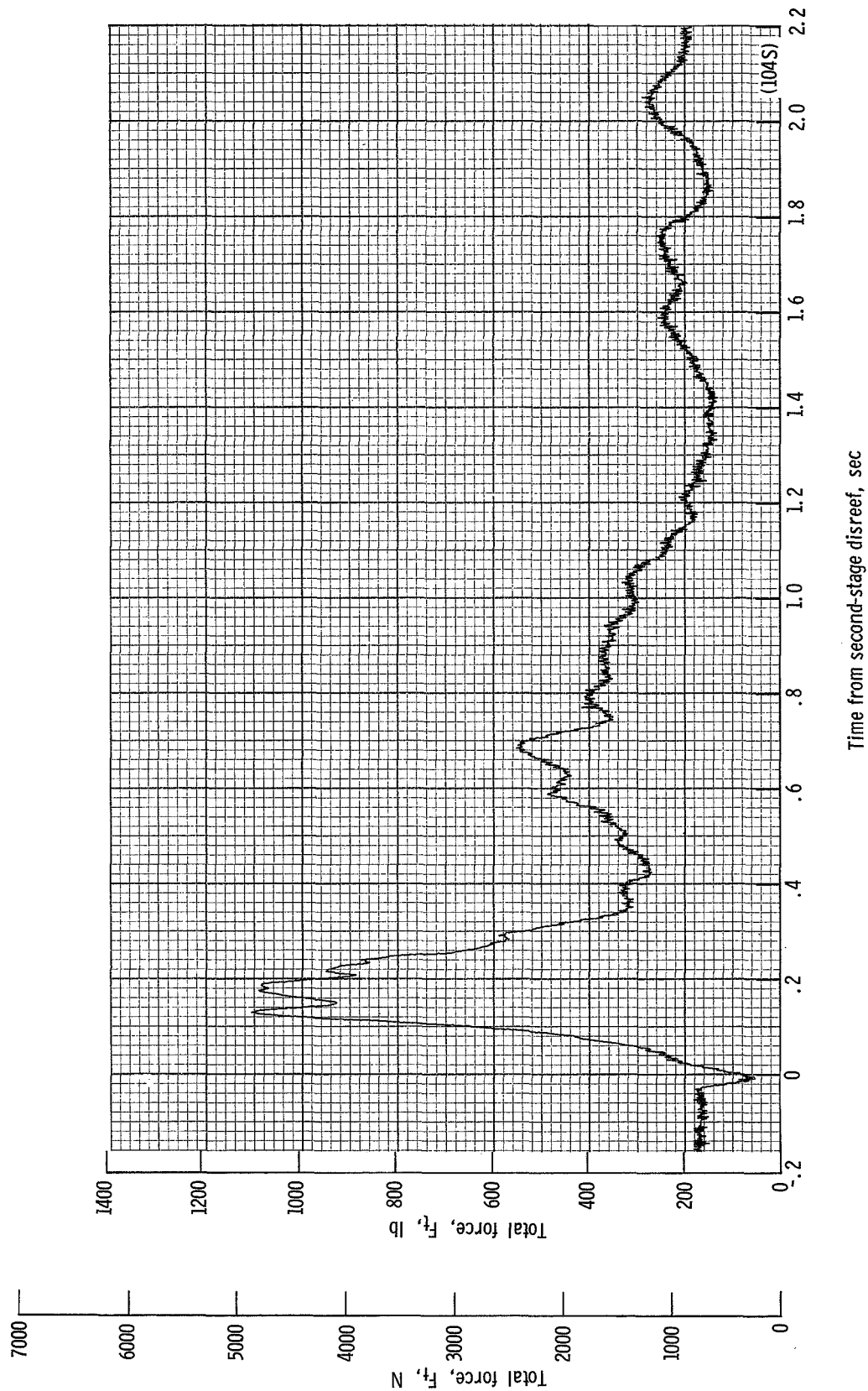
Figure 18.- Continued.



Time from second-stage disreef, sec

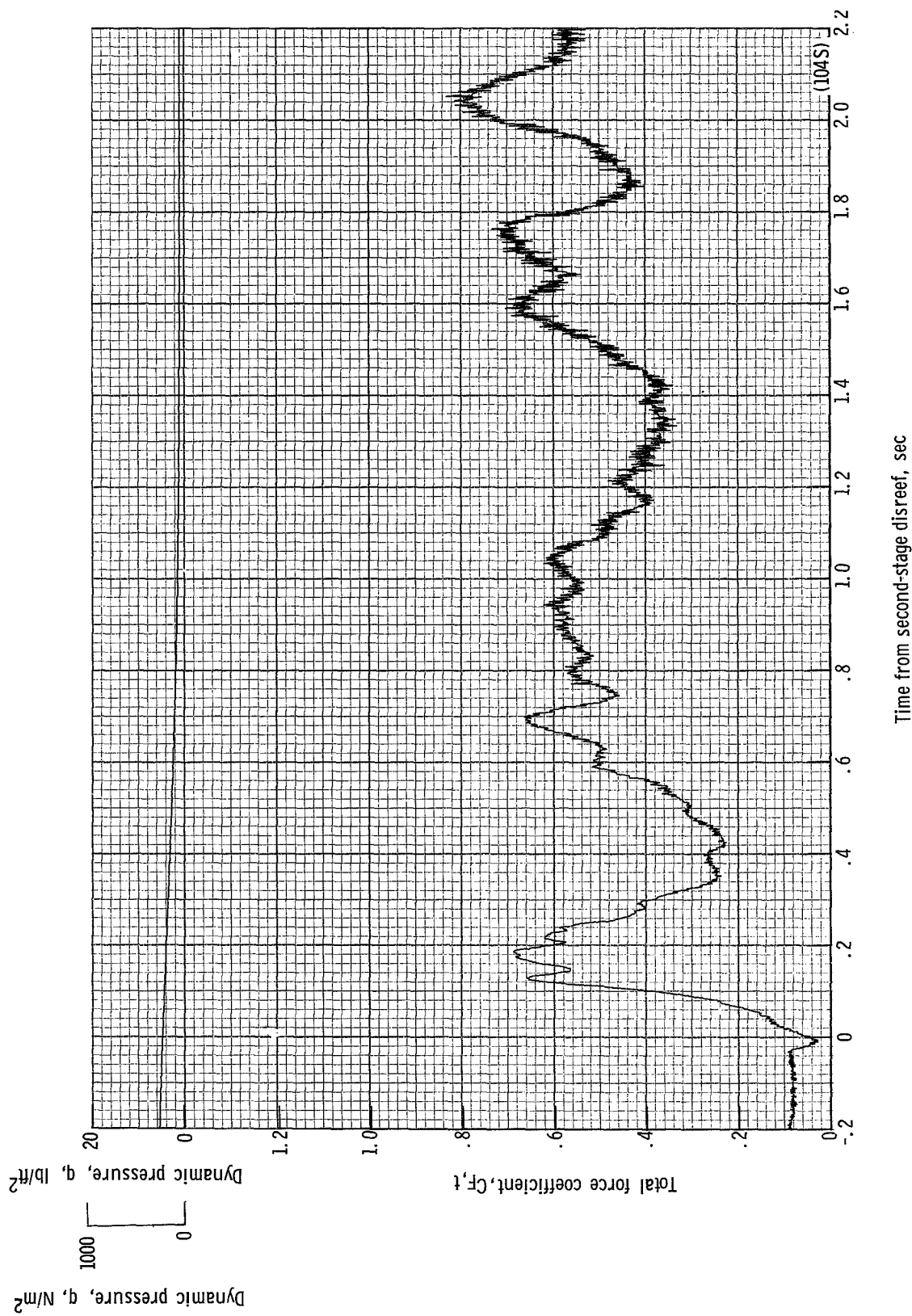
(m) Accelerations a_y , a_x , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 16.45 seconds after launch.

Figure 18.- Continued.

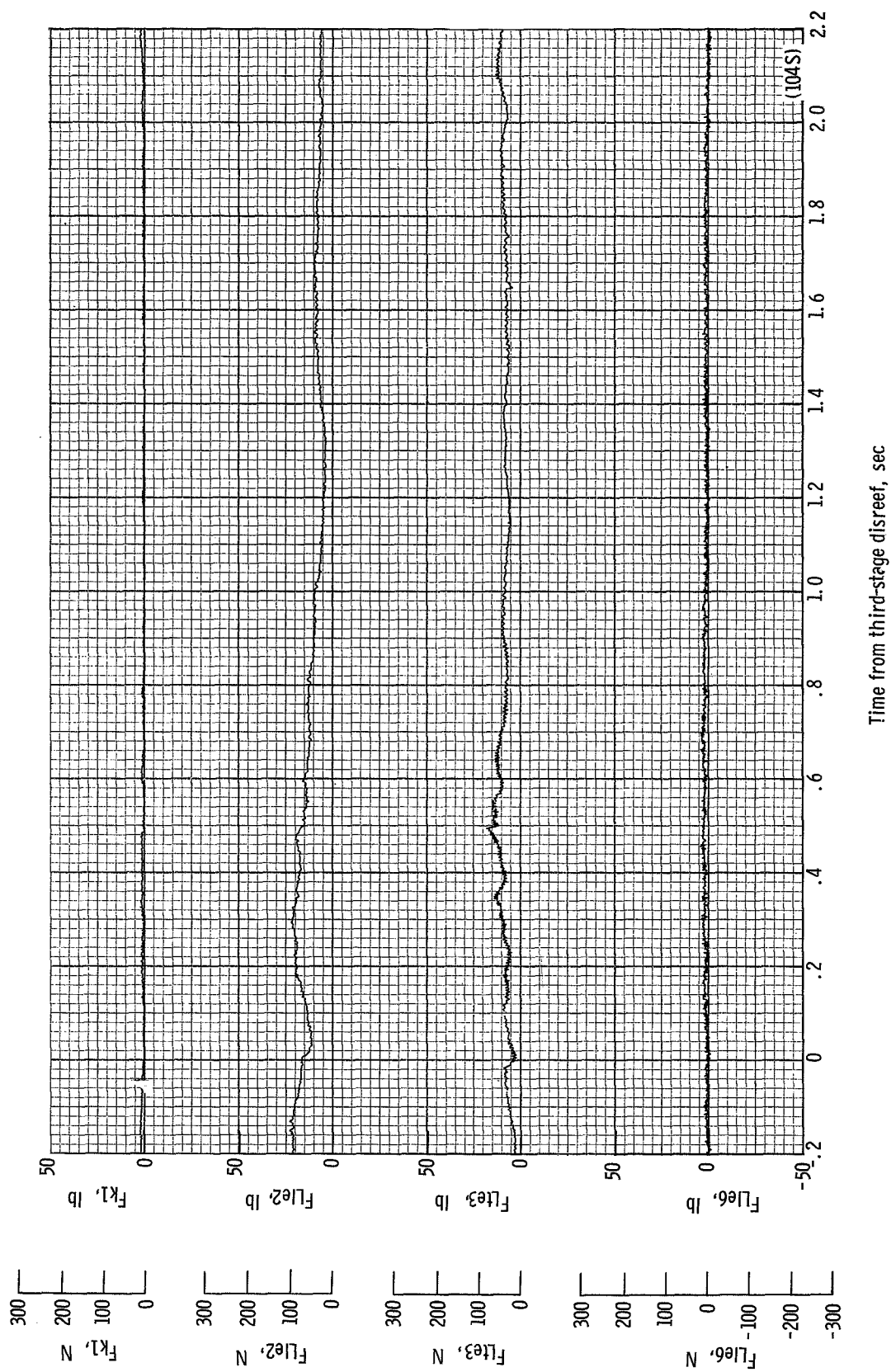


(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 16.45 seconds after launch.

Figure 18.- Continued.

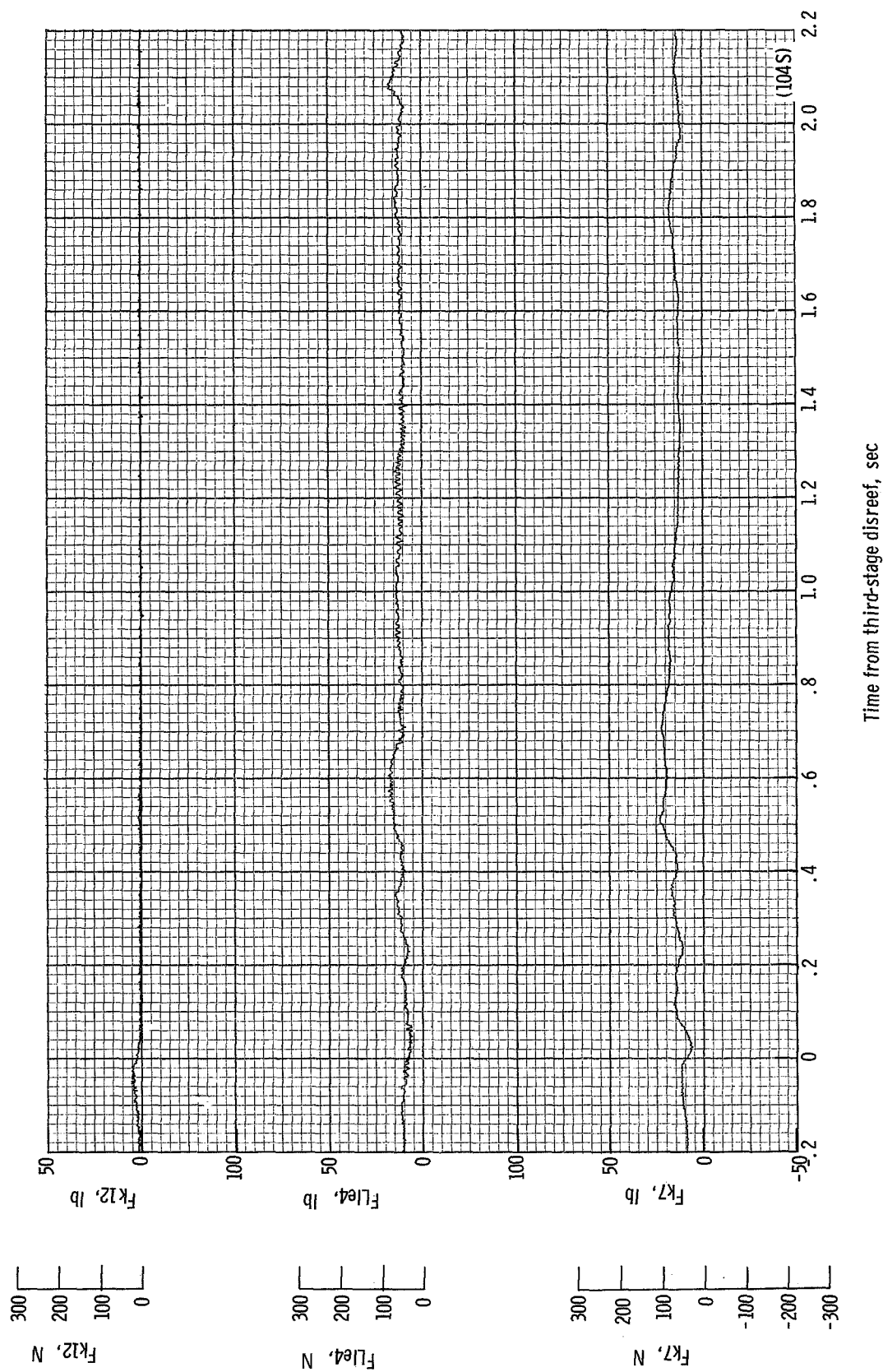


(b) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 16.45 seconds after launch.



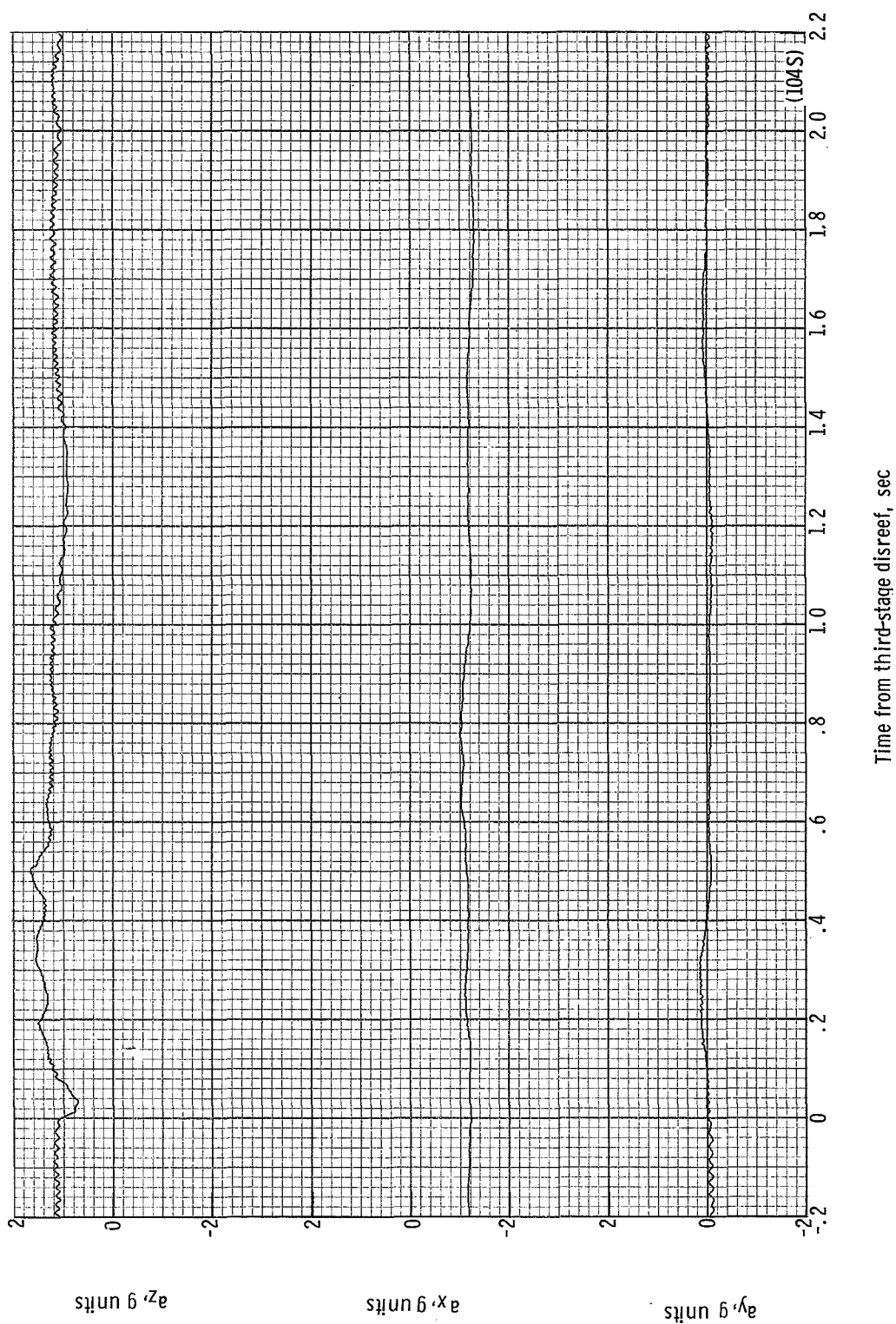
(p) Individual suspension-line loads F_{lie6} , F_{lie3} , F_{lie2} , and F_{k1} plotted against time from third-stage disreef. Time = 0 second corresponds to 20.39 seconds after launch.

Figure 18.- Continued.



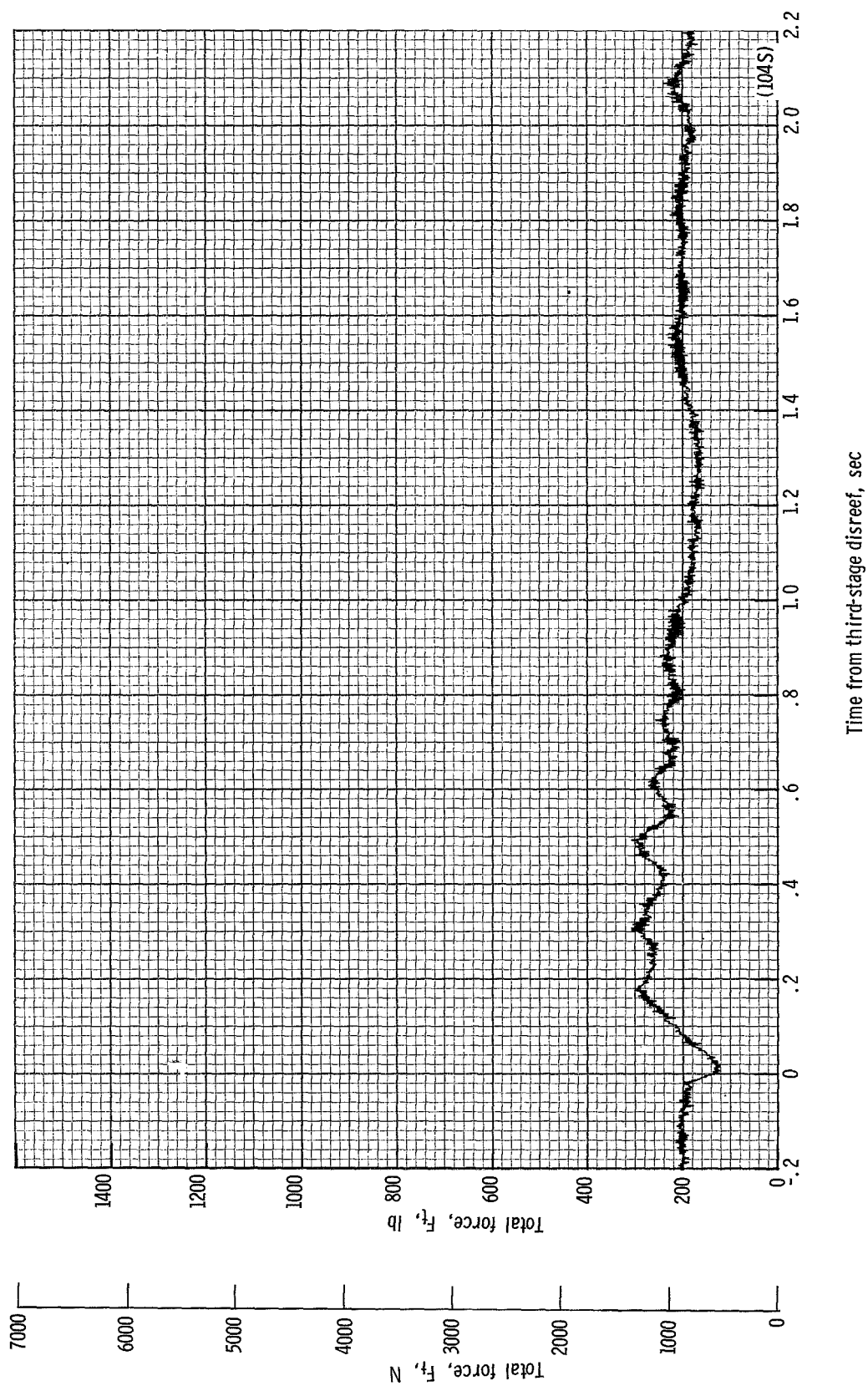
(q) Individual suspension-line loads F_{k7} , F_{Le4} and F_{k12} plotted against time from third-stage disreef. Time = 0 second corresponds to 20.39 seconds after launch.

Figure 18.- Continued.



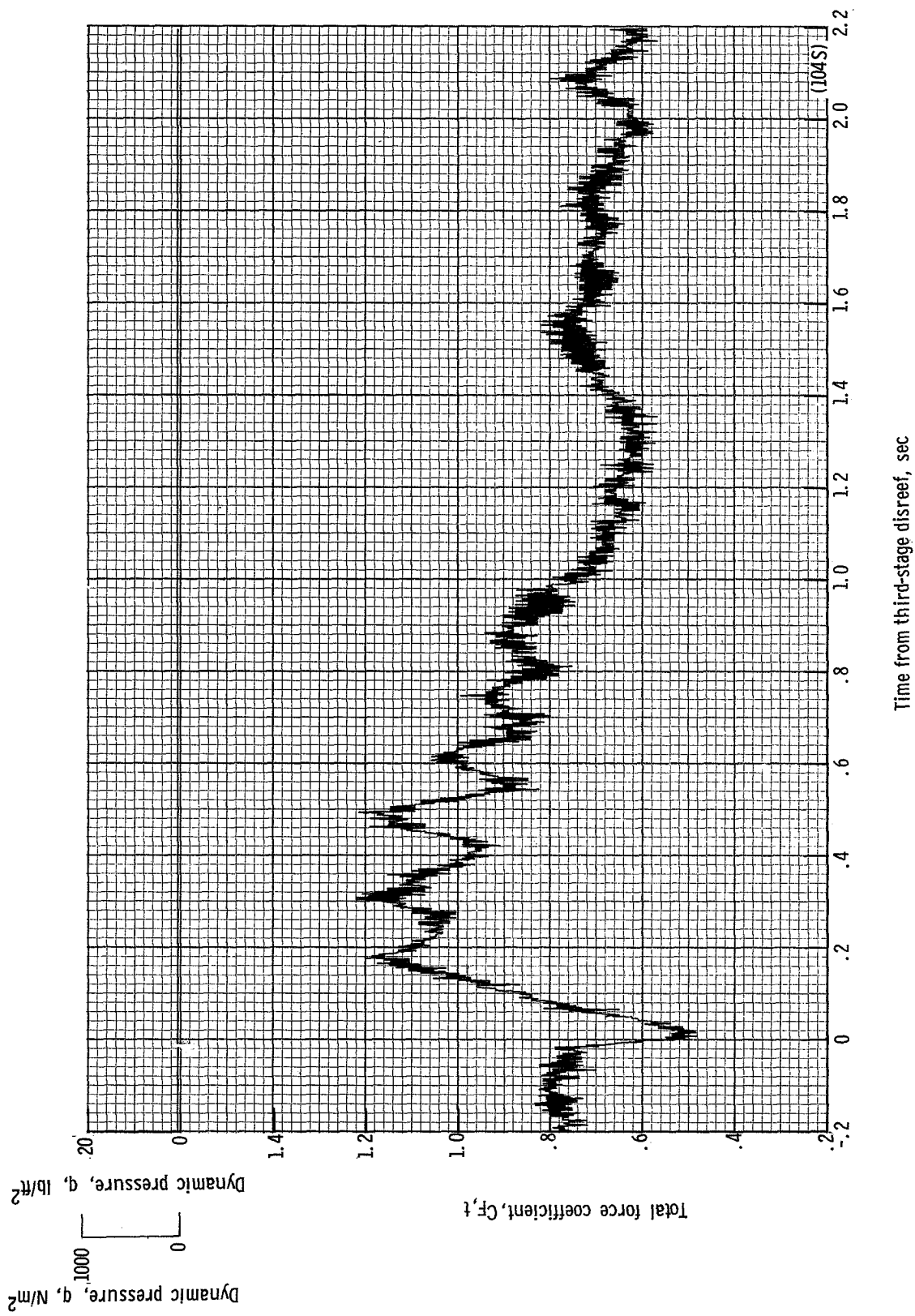
(r) Accelerations a_y , a_x , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 20.39 seconds after launch.

Figure 18.- Continued.



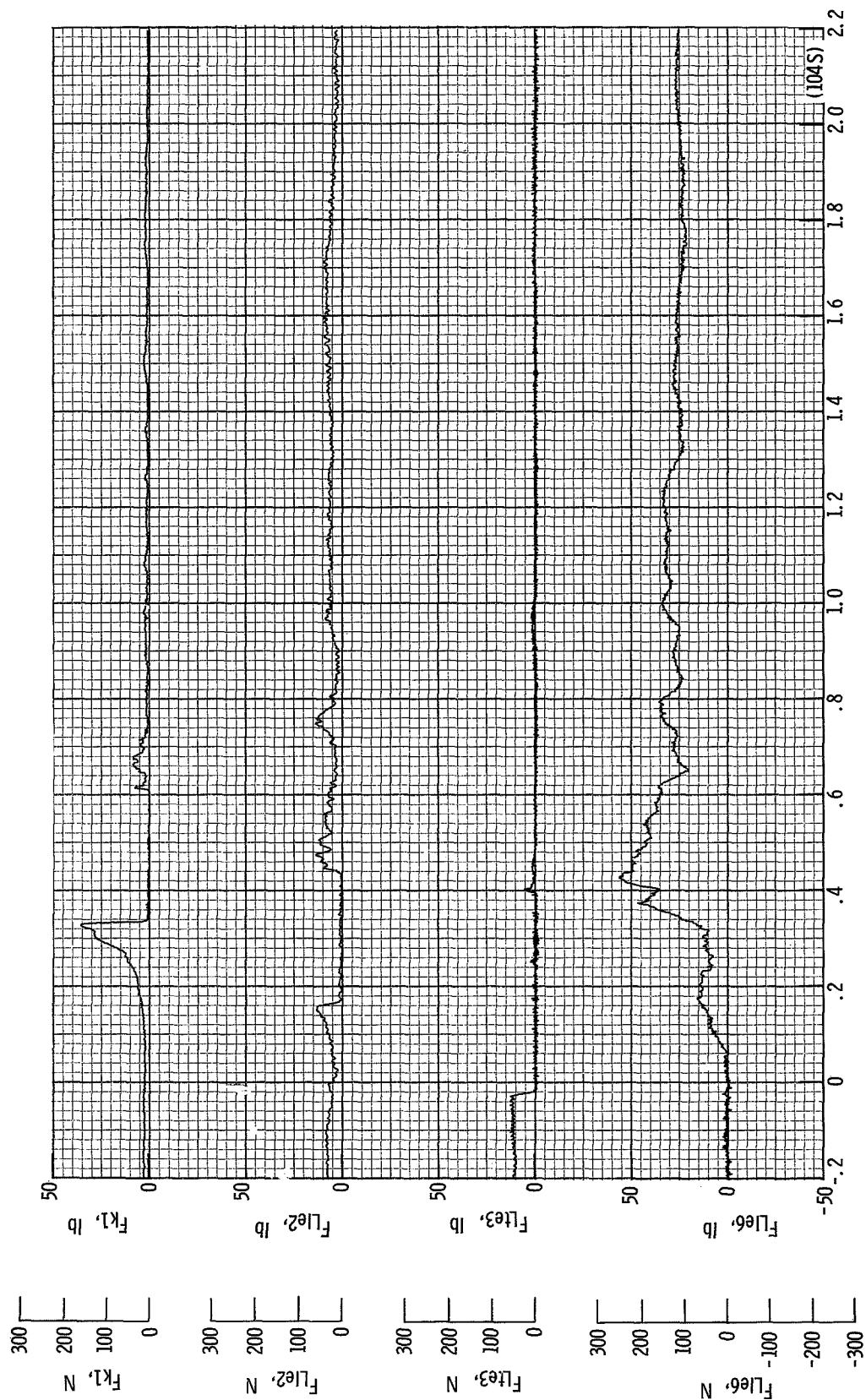
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 20.39 seconds after launch.

Figure 18.- Continued.



(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 20.39 seconds after launch.

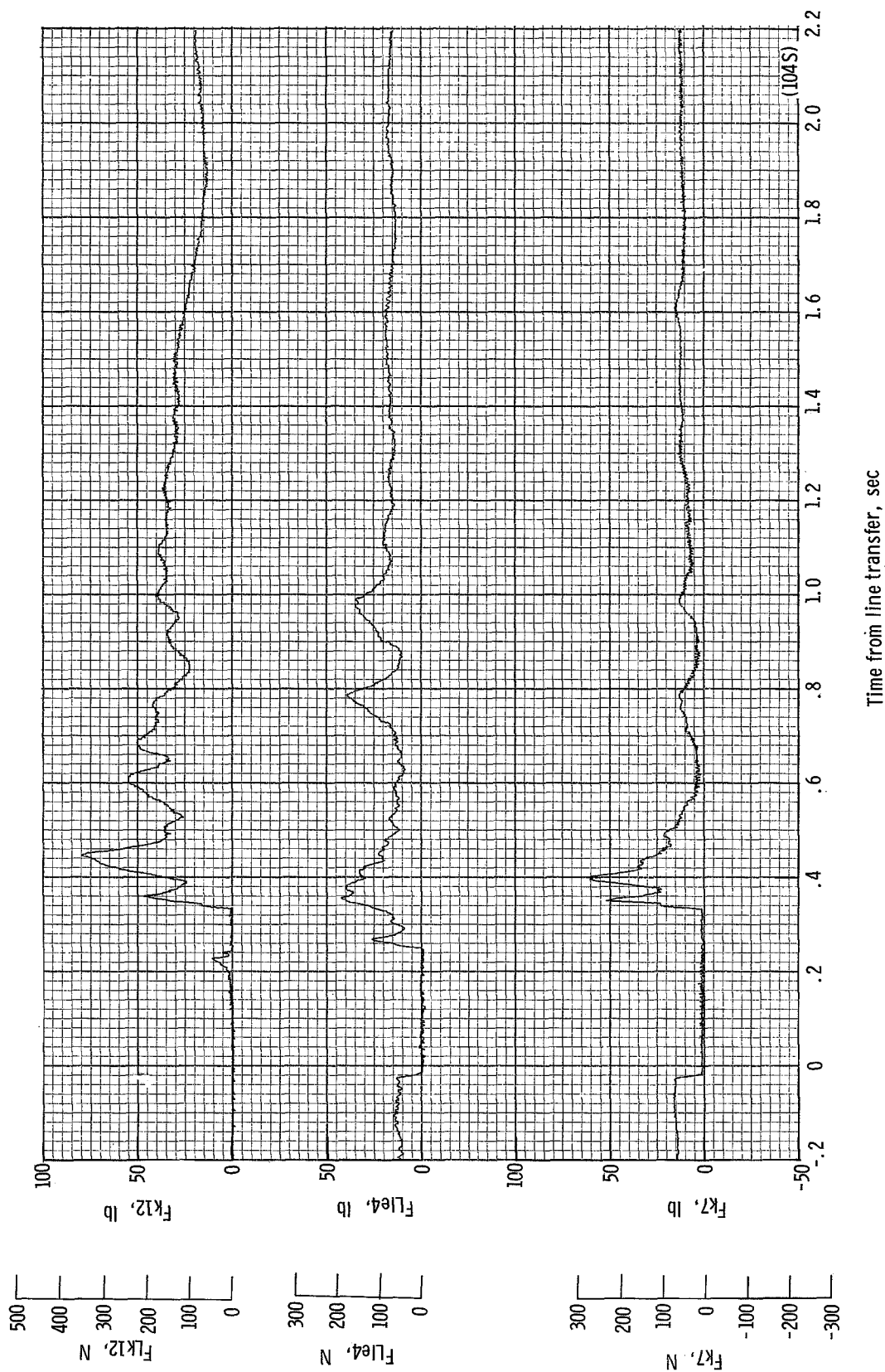
Figure 18.- Continued.



Time from line transfer, sec

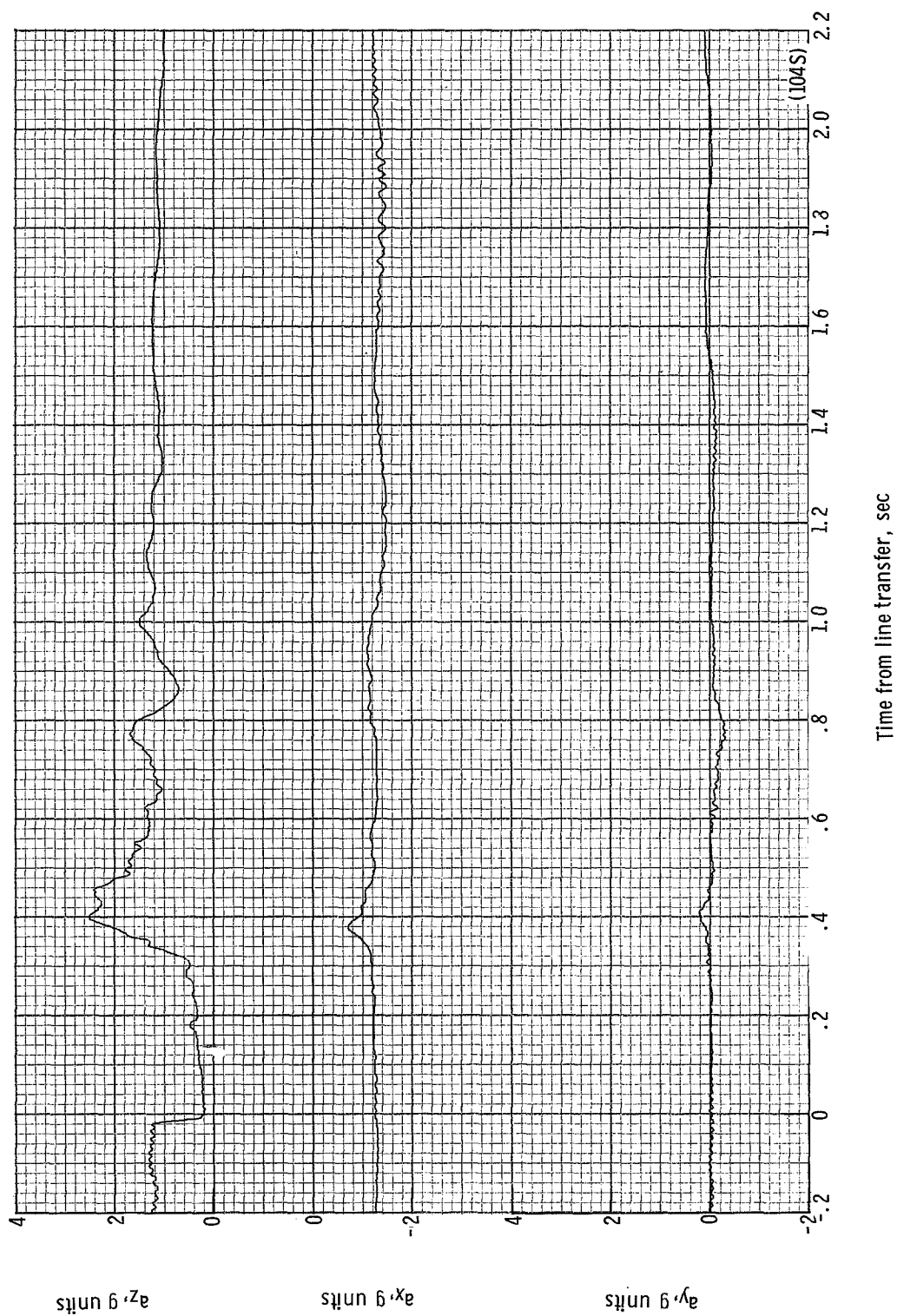
(u) Individual suspension-line loads F_{le6} , F_{te3} , F_{le2} , and F_{k1} plotted against time from line transfer. Time = 0 second corresponds to 22.85 seconds after launch.

Figure 18.- Continued.



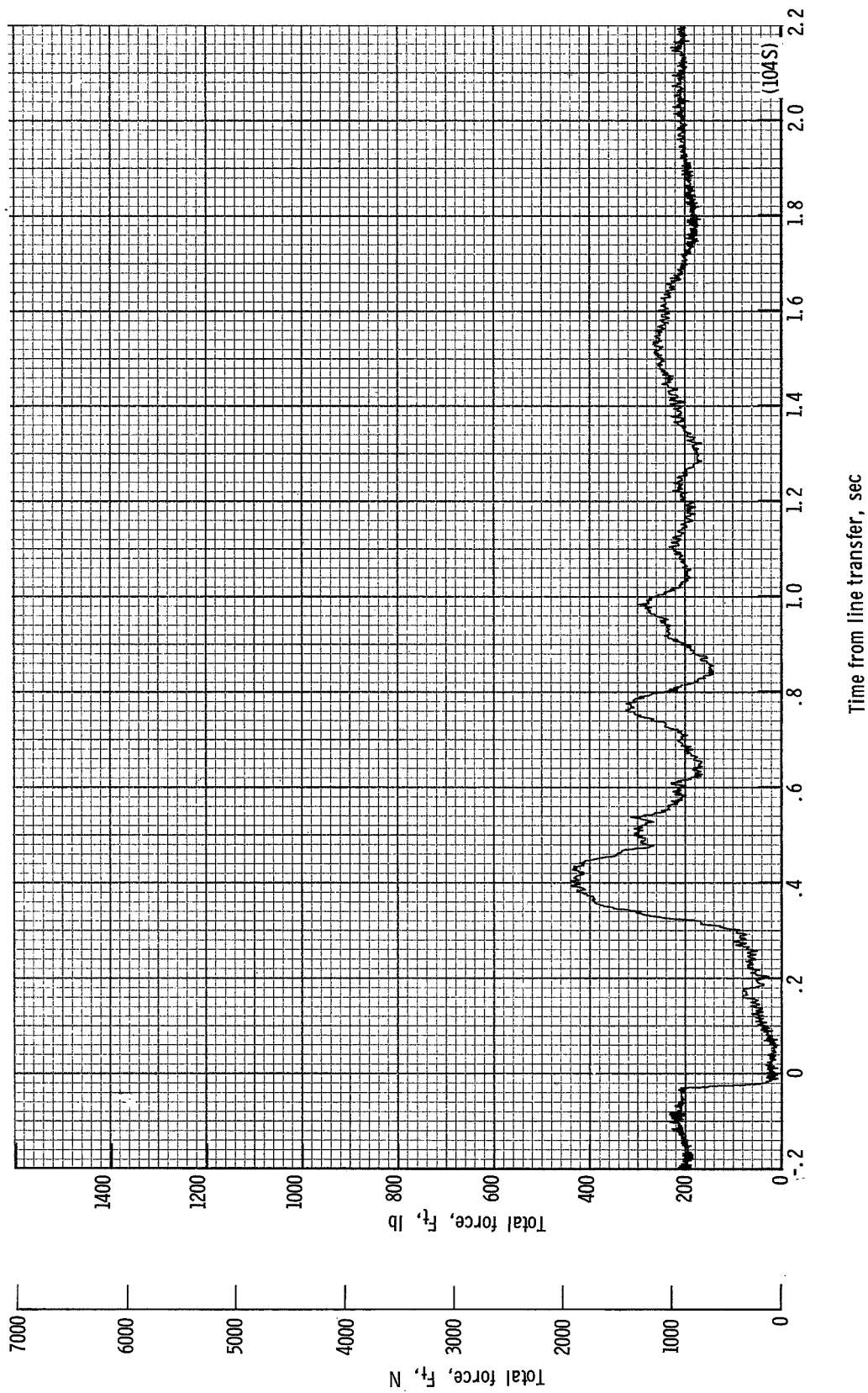
(v) Individual suspension-line loads F_{k7} , F_{Le4} , and F_{k12} plotted against time from line transfer. Time = 0 second corresponds to 22.85 seconds after launch.

Figure 18.- Continued.



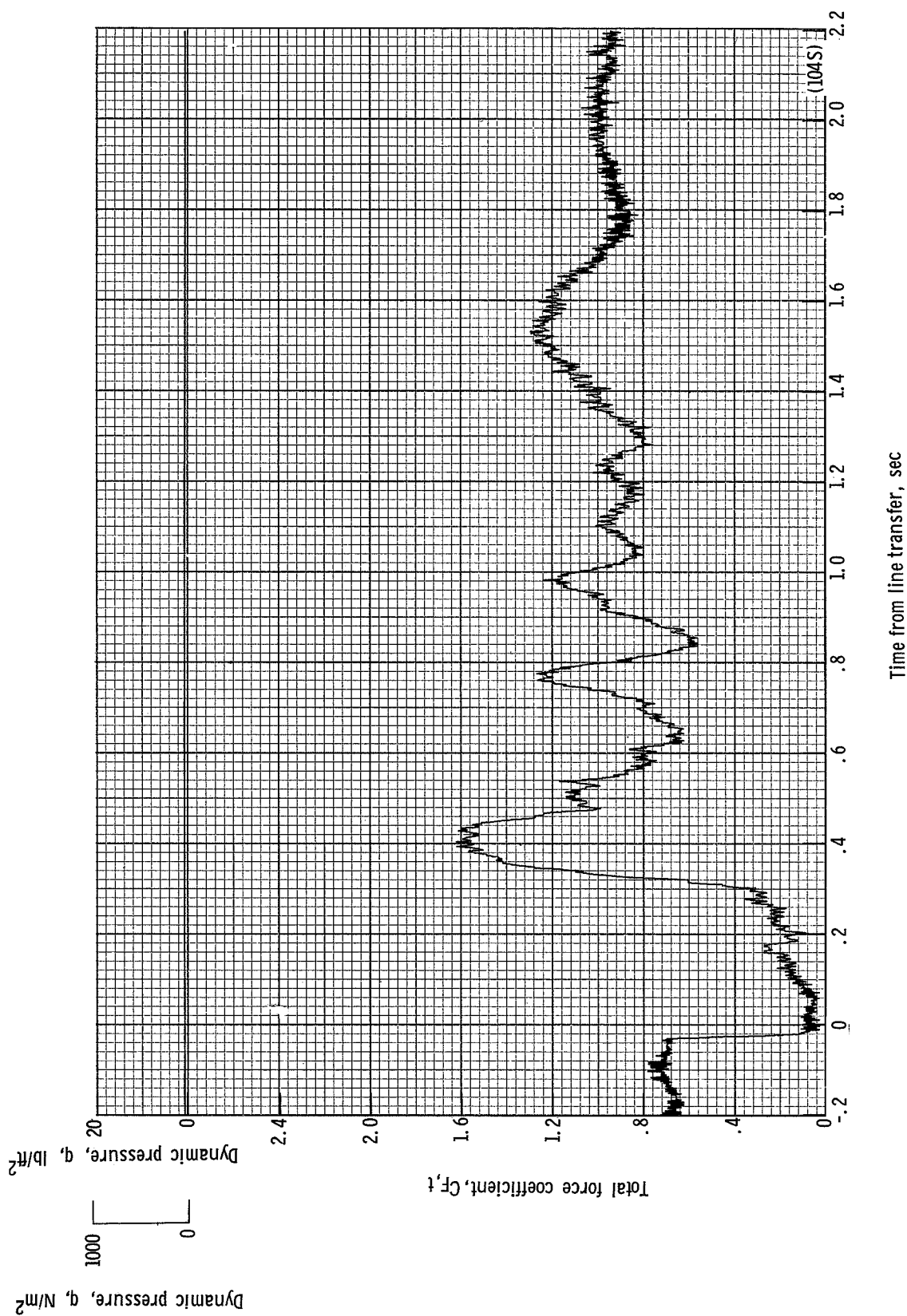
(w) Accelerations a_y , a_x , and a_z plotted against time from line transfer. Time = 0 second corresponds to 22.85 seconds after launch.

Figure 18.- Continued.



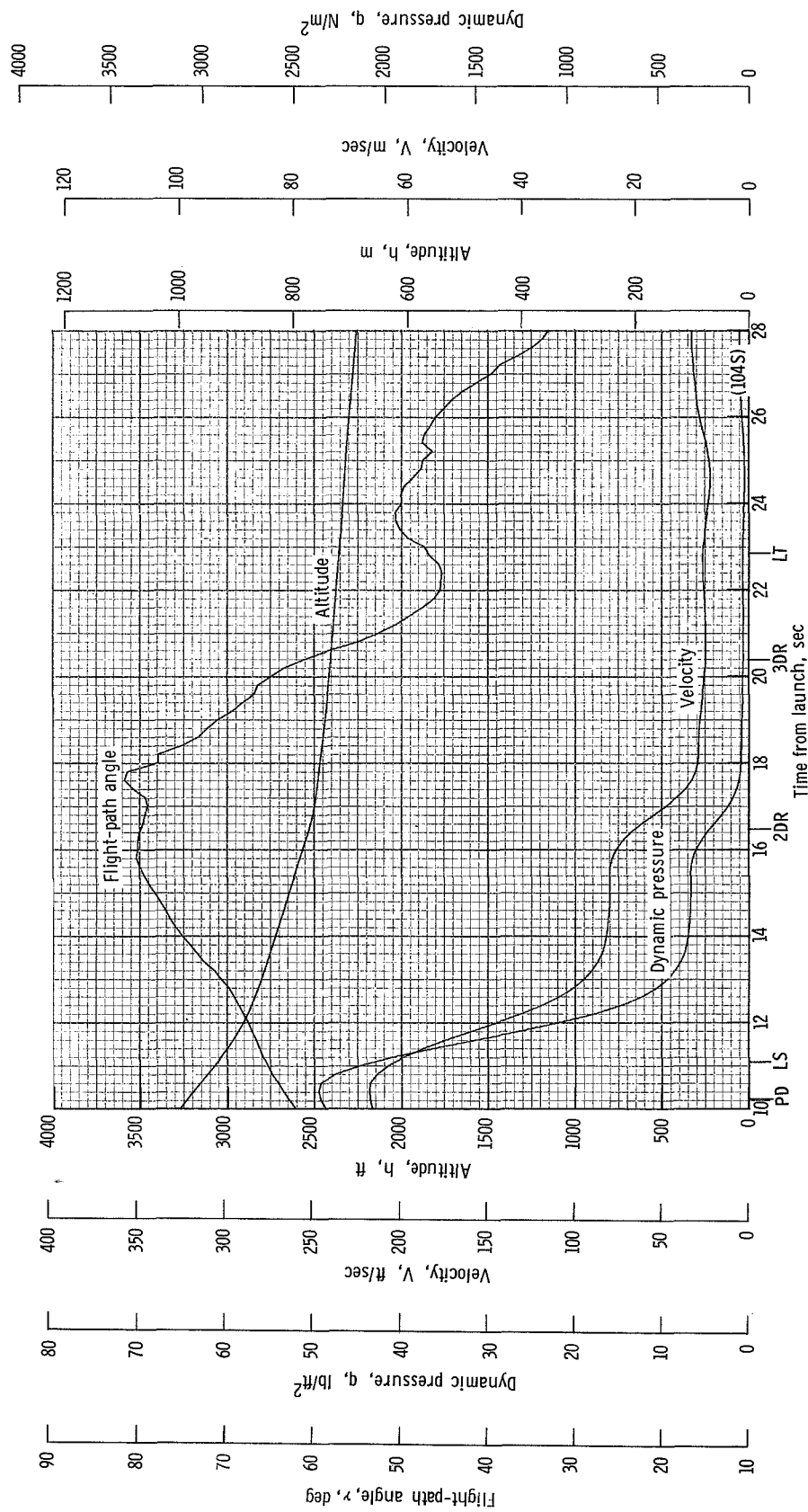
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 22.85 seconds after launch.

Figure 18.- Continued.



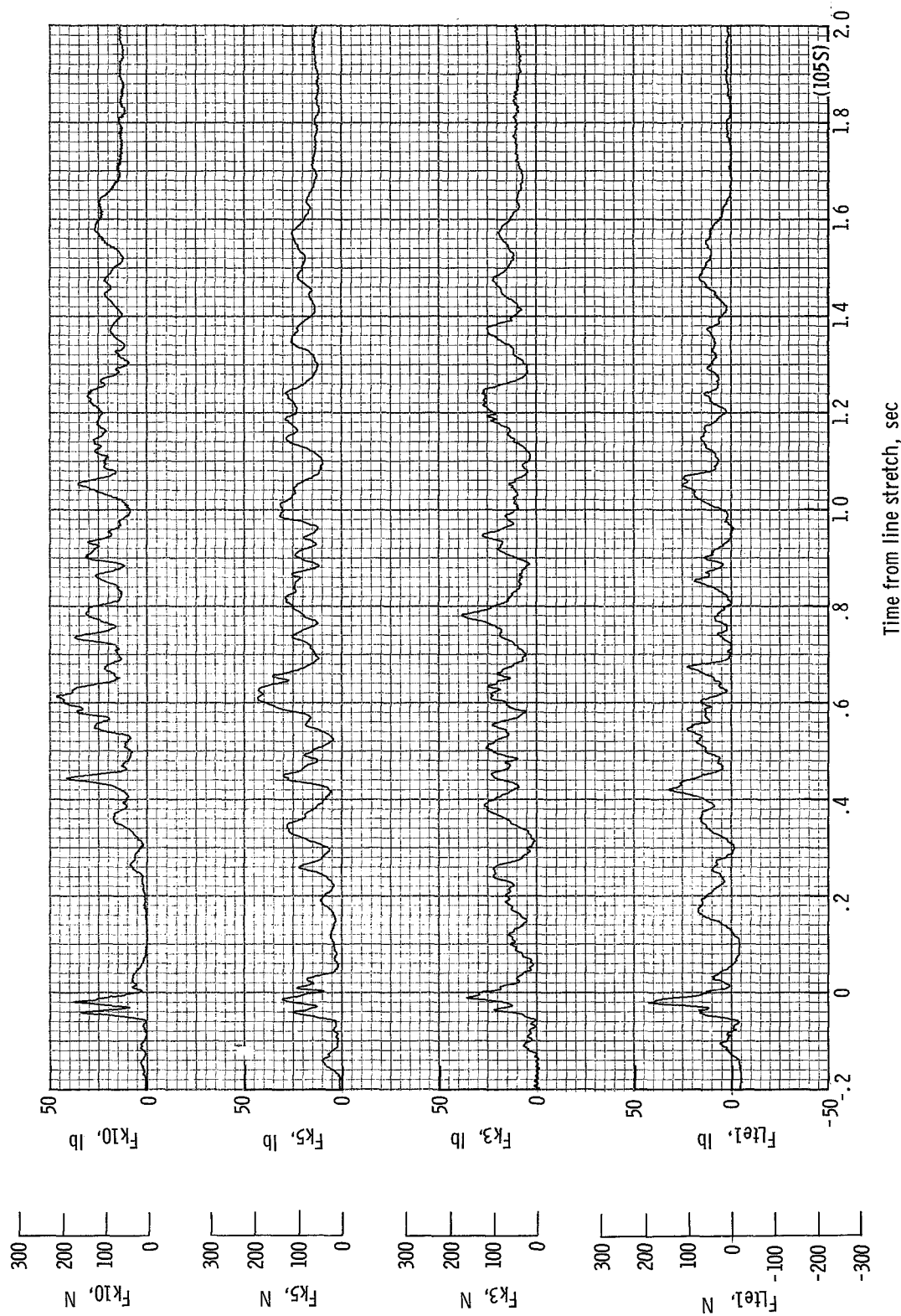
(y) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 22.85 seconds after launch.

Figure 18.- Continued.



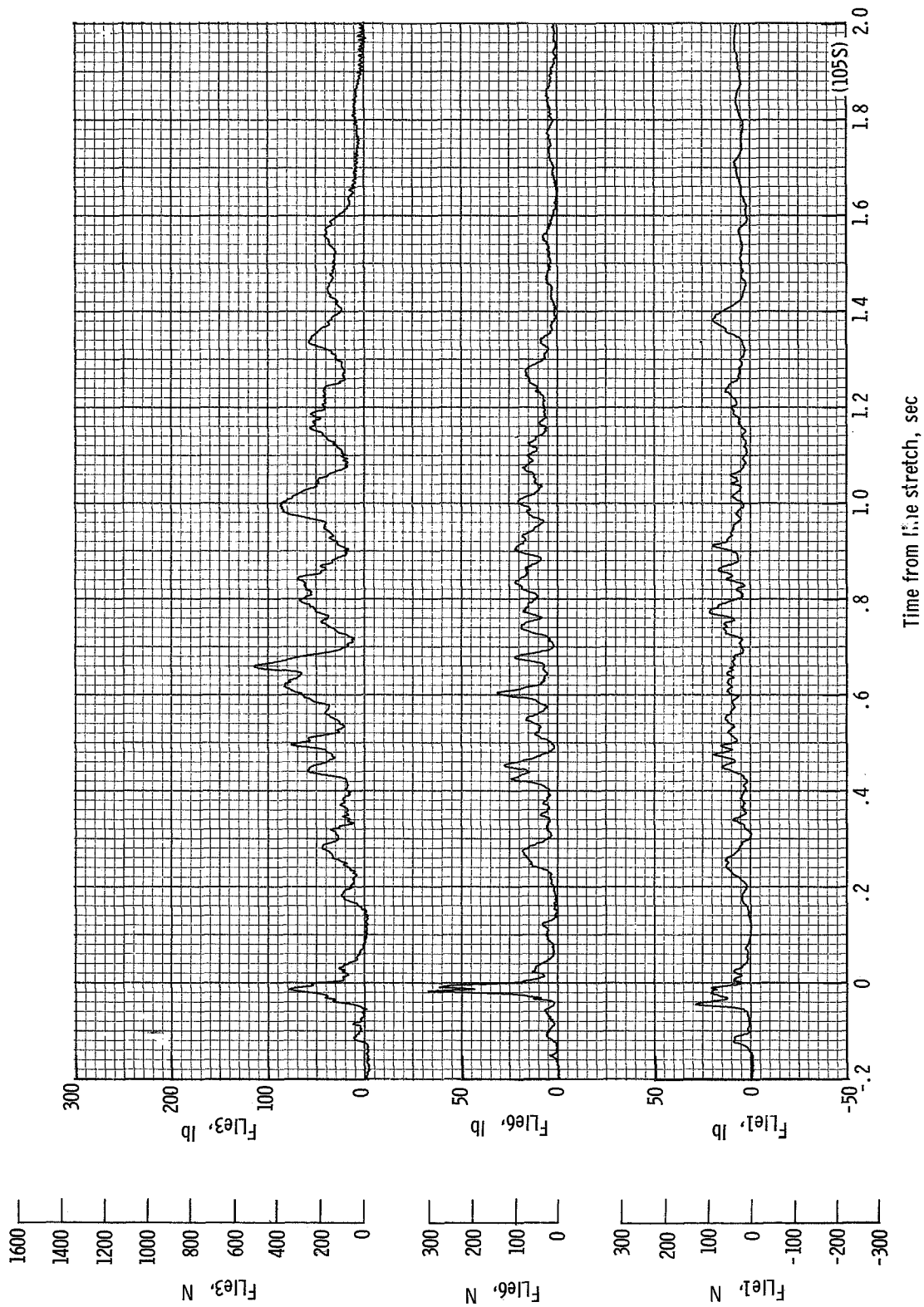
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 18.- Concluded.



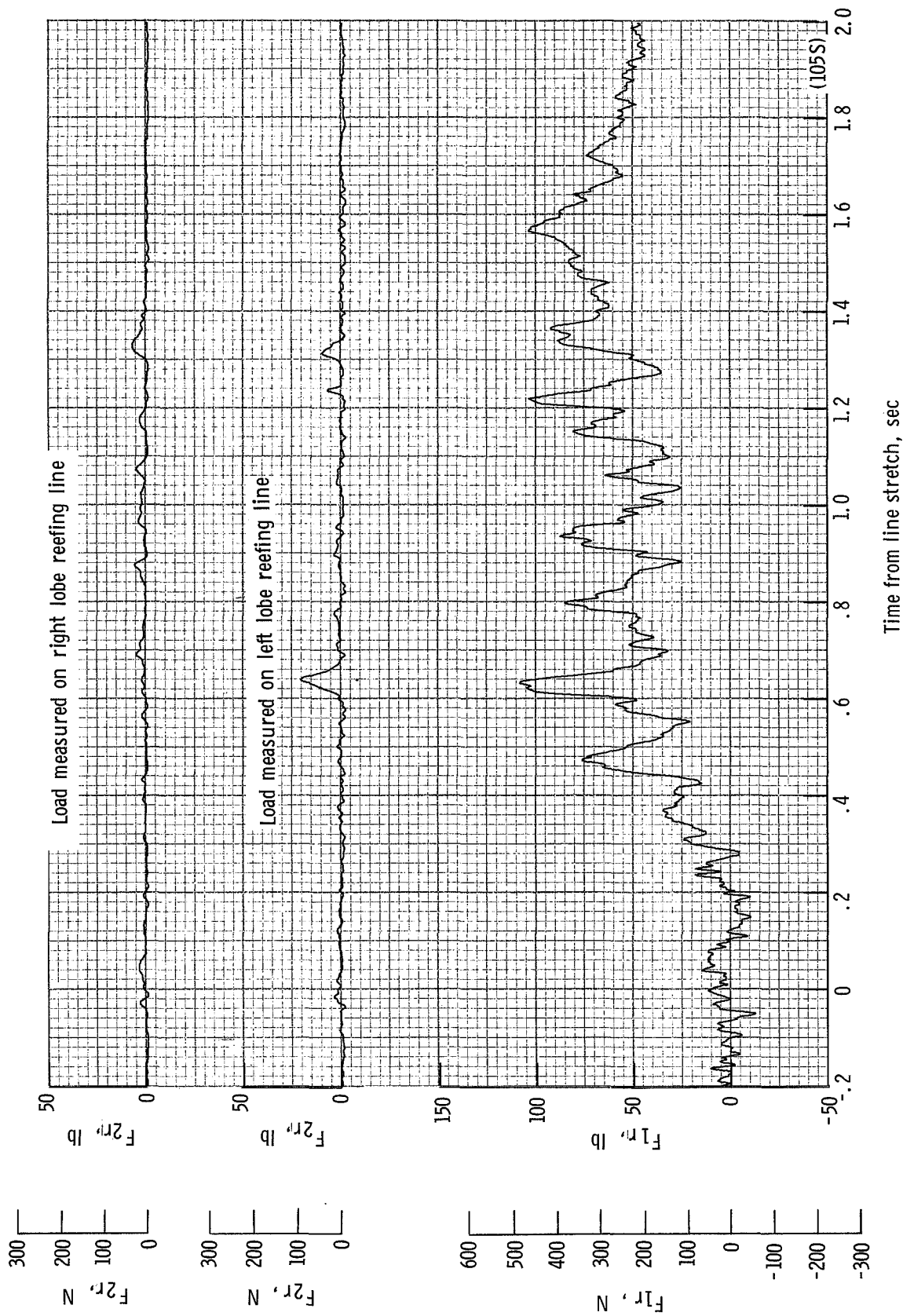
(a) Individual suspension-line loads F_{k1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from line stretch. Time = 0 second corresponds to 24.86 seconds after launch.

Figure 19.- Time history of single-keel parawing deployment data for test 105S. $W_D = 1138.3$ N (255.9 lb); $W_P = 991.1$ N (222.8 lb); $q_{PD} = 2063.6$ N/m² (43.1 lb/ft²); $h_{PD} = 1024$ m (3361 ft); $l_v/l_k = 0.126$; reefing version 11.



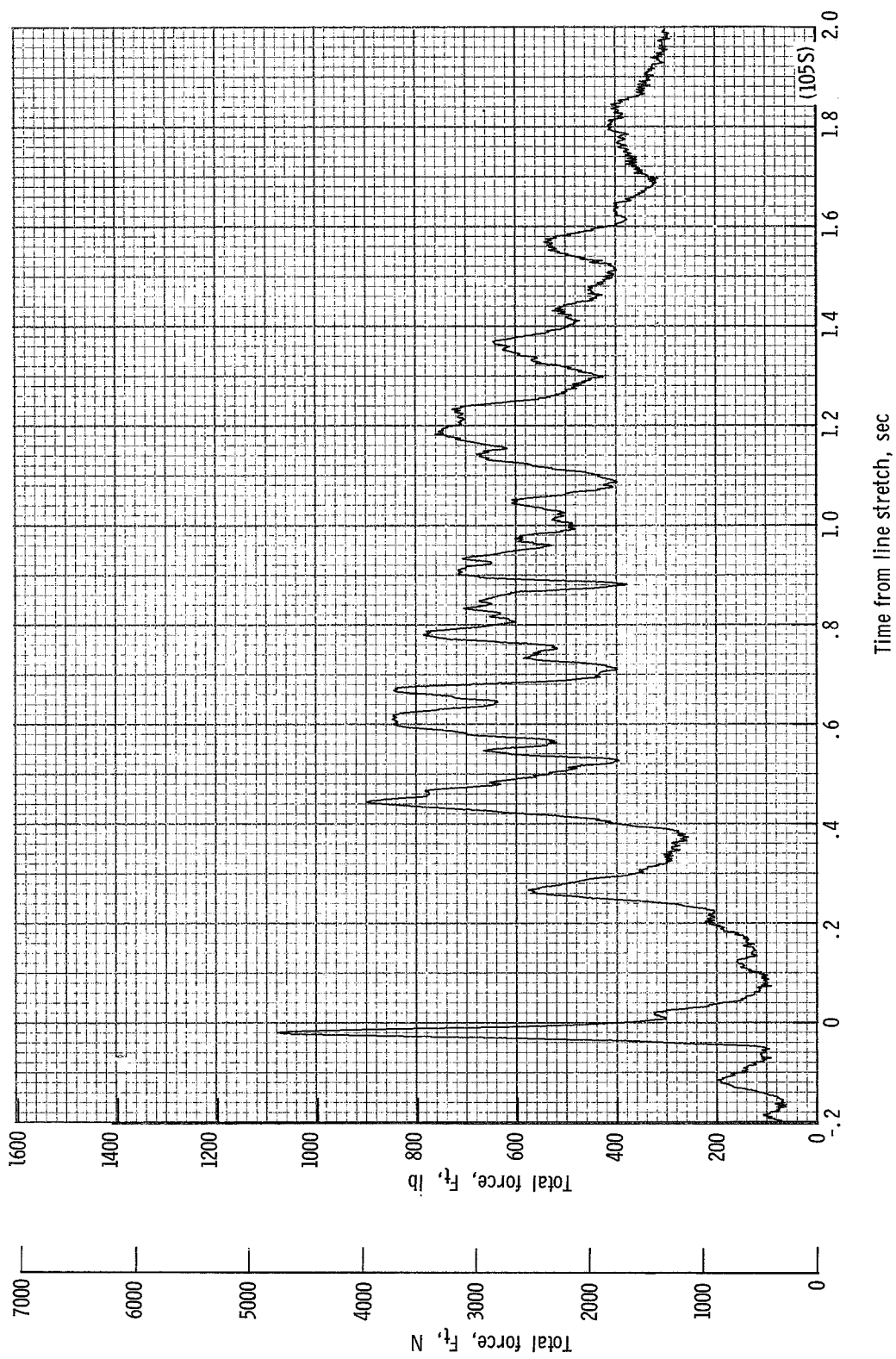
(b) Individual suspension-line loads F_{Lie1} , F_{Lie6} and F_{Lie3} plotted against time from line stretch. Time = 0 second corresponds to 24.86 seconds after launch.

Figure 19.- Continued.



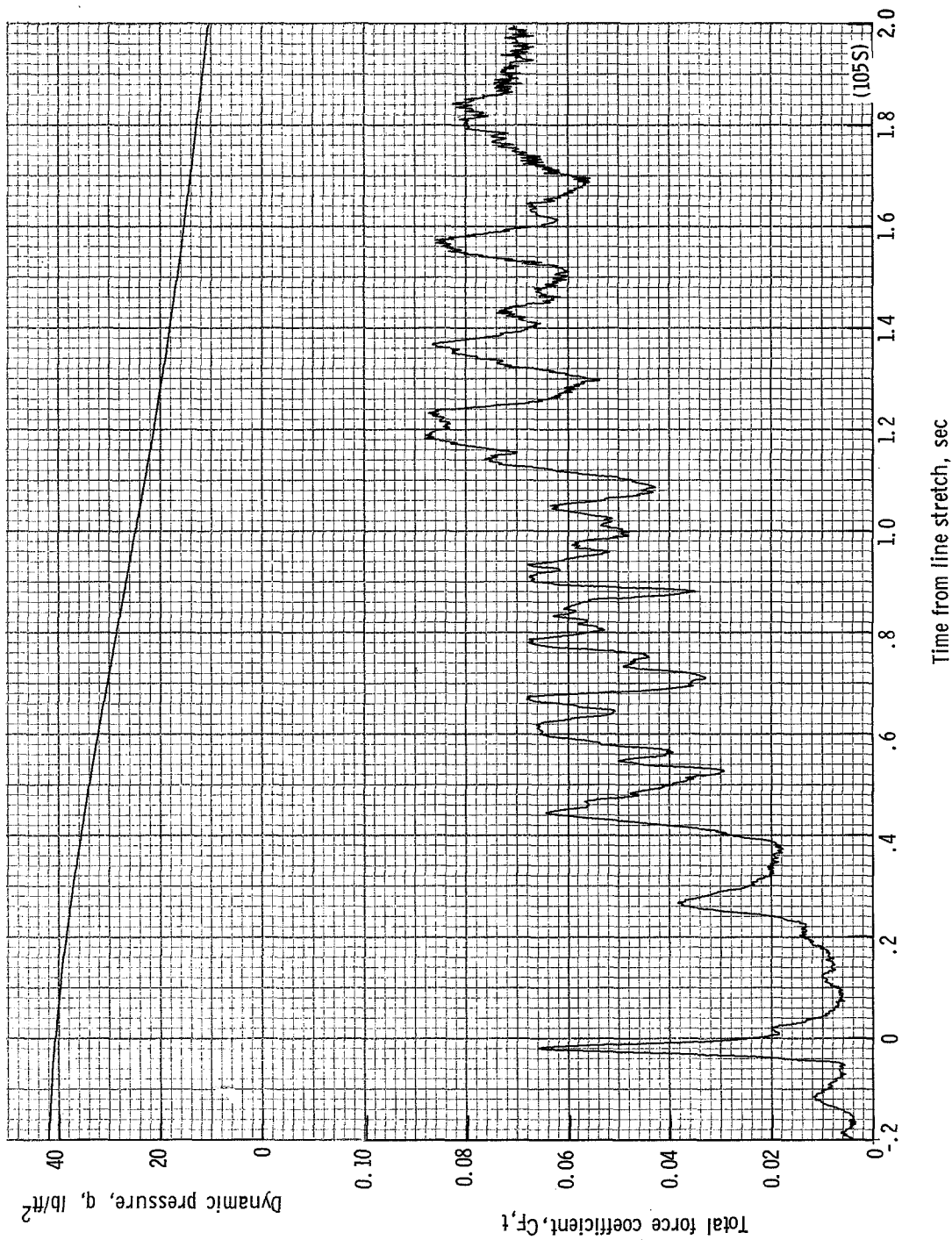
(c) Individual reefing-line loads F_{1r} , F_{2r} , and F_{2l} plotted against time from line stretch. Time = 0 second corresponds to 24.86 seconds after launch.

Figure 19.- Continued.



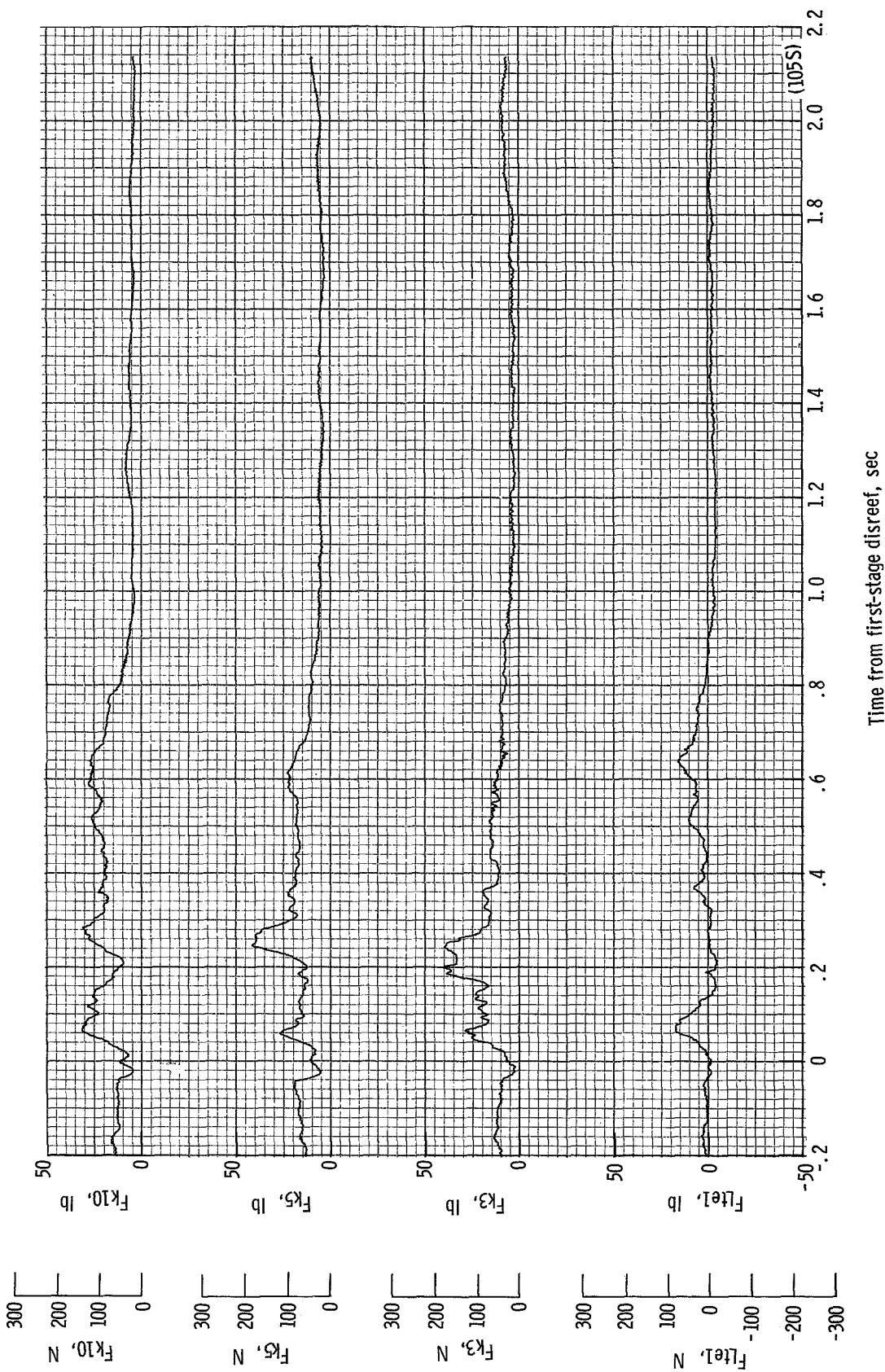
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 24.86 seconds after launch.

Figure 19.- Continued.



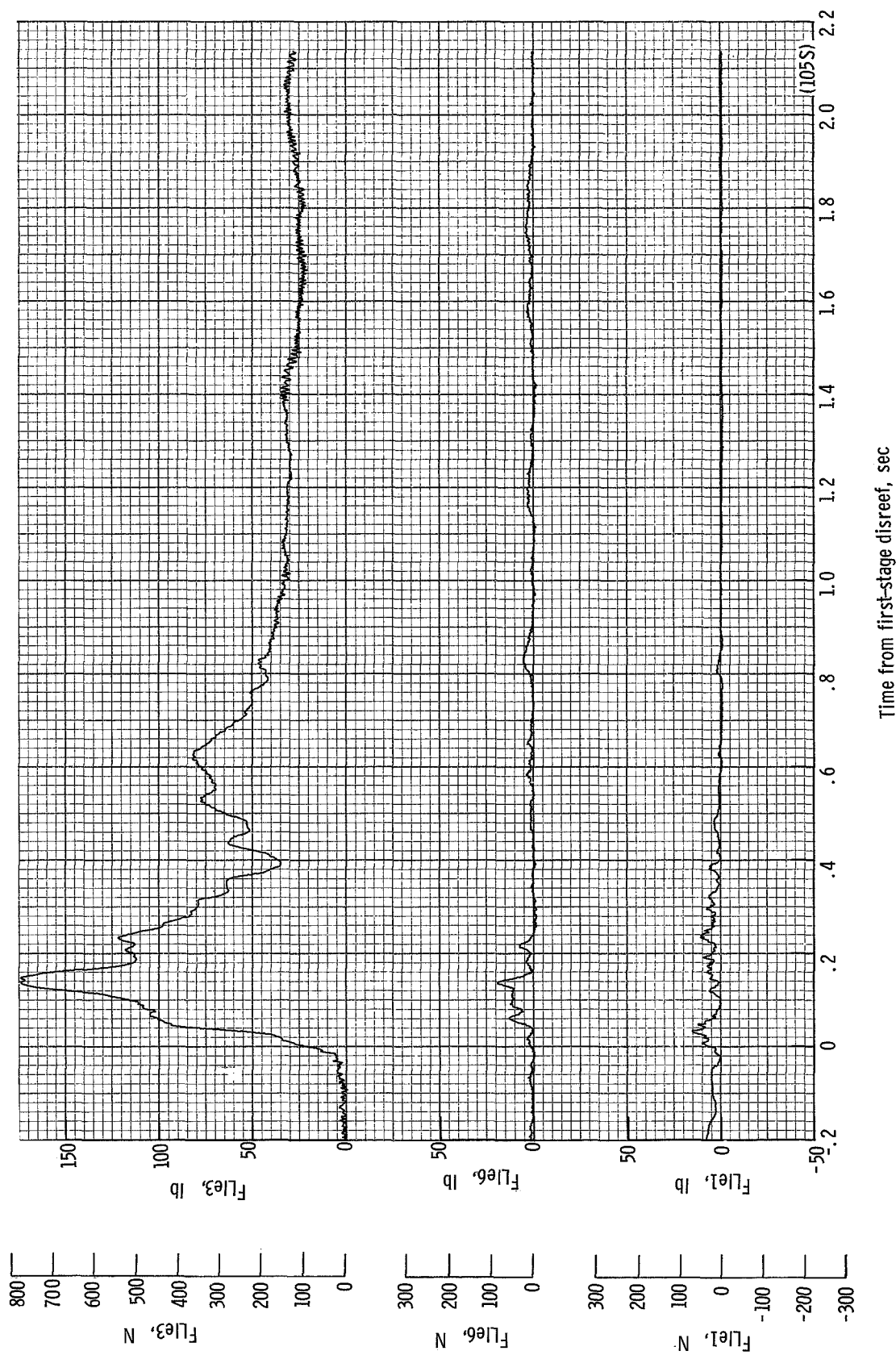
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 24.86 seconds after launch.

Figure 19.- Continued.



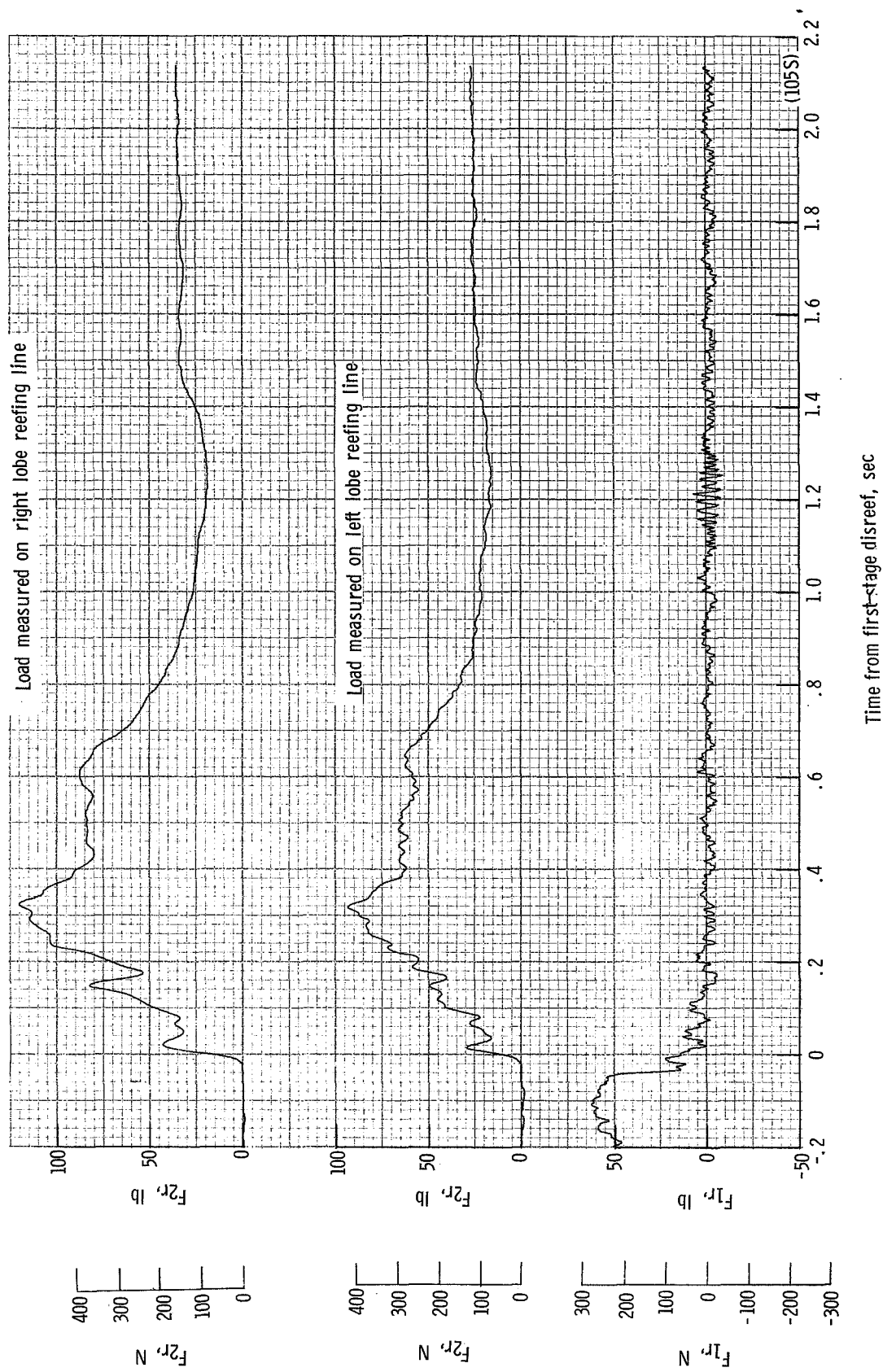
(f) Individual suspension-line loads F_{k10} , F_{k5} , and F_{k3} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.98 seconds after launch.

Figure 19.- Continued.



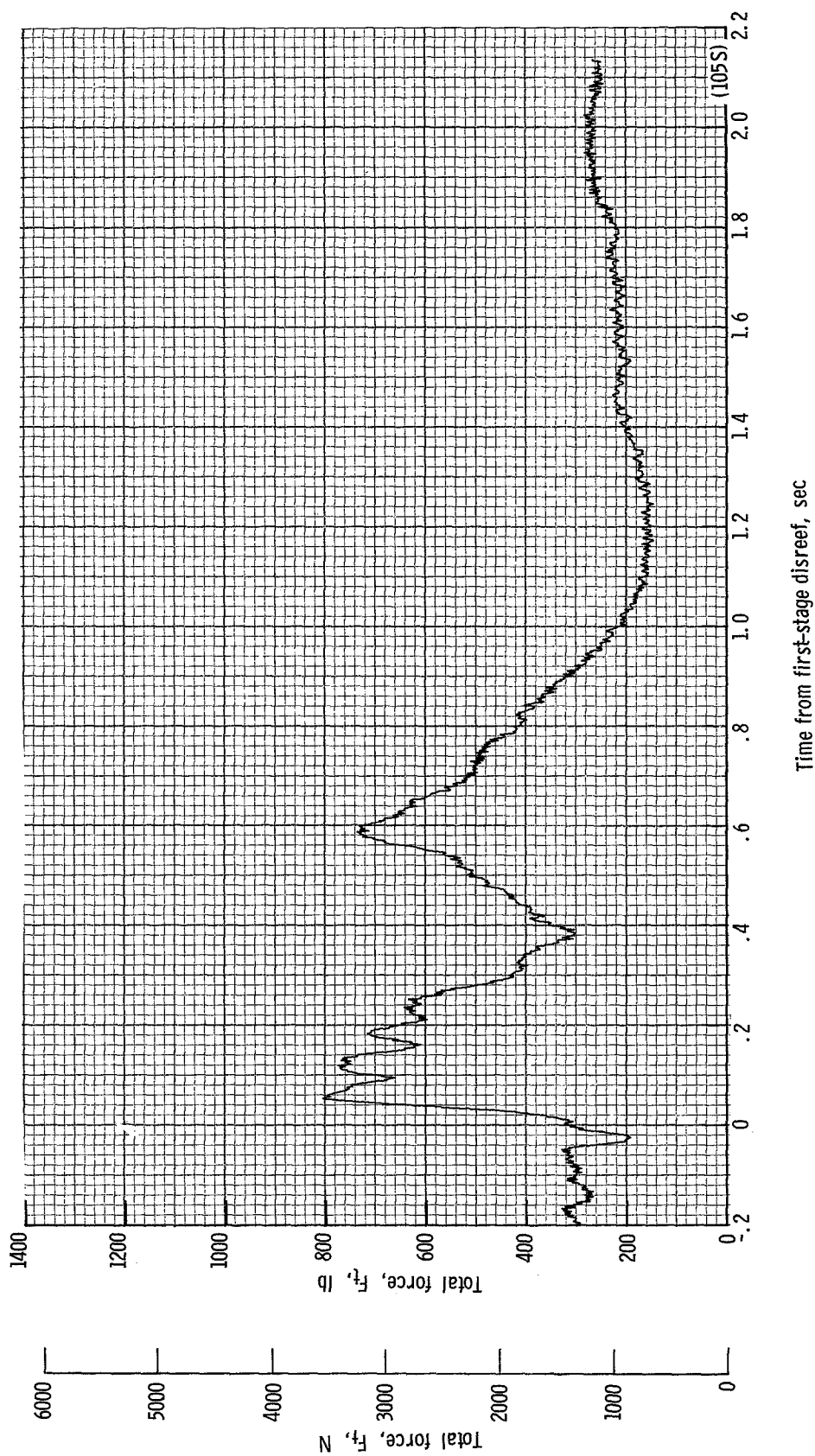
(g) Individual suspension-line loads F_{L1e1} , F_{L1e6} and F_{L1e3} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.98 seconds after launch.

Figure 19.- Continued.



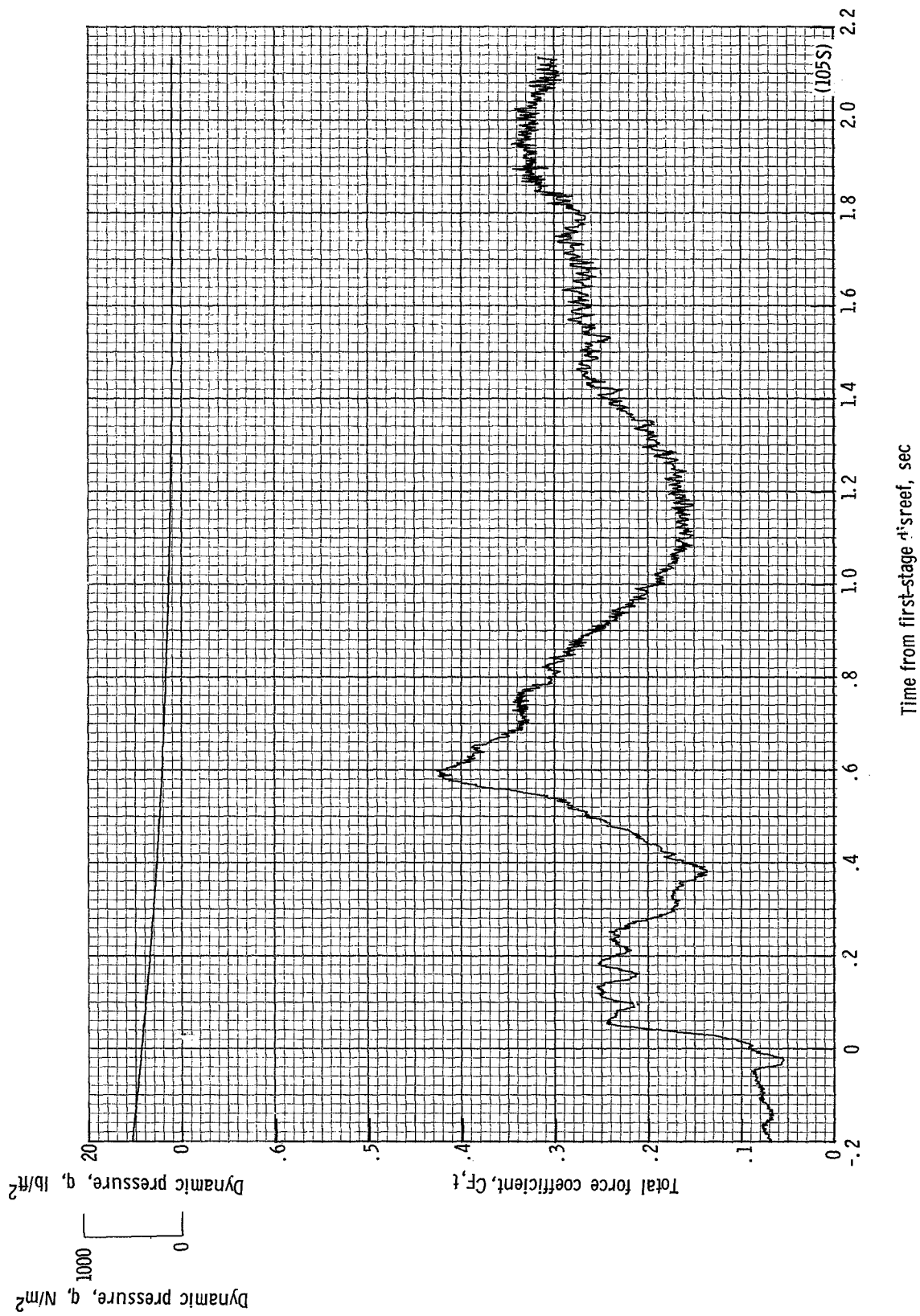
(h) Individual reefing-line loads F_{1r} and F_{2r} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.98 seconds after launch.

Figure 19.- Continued.



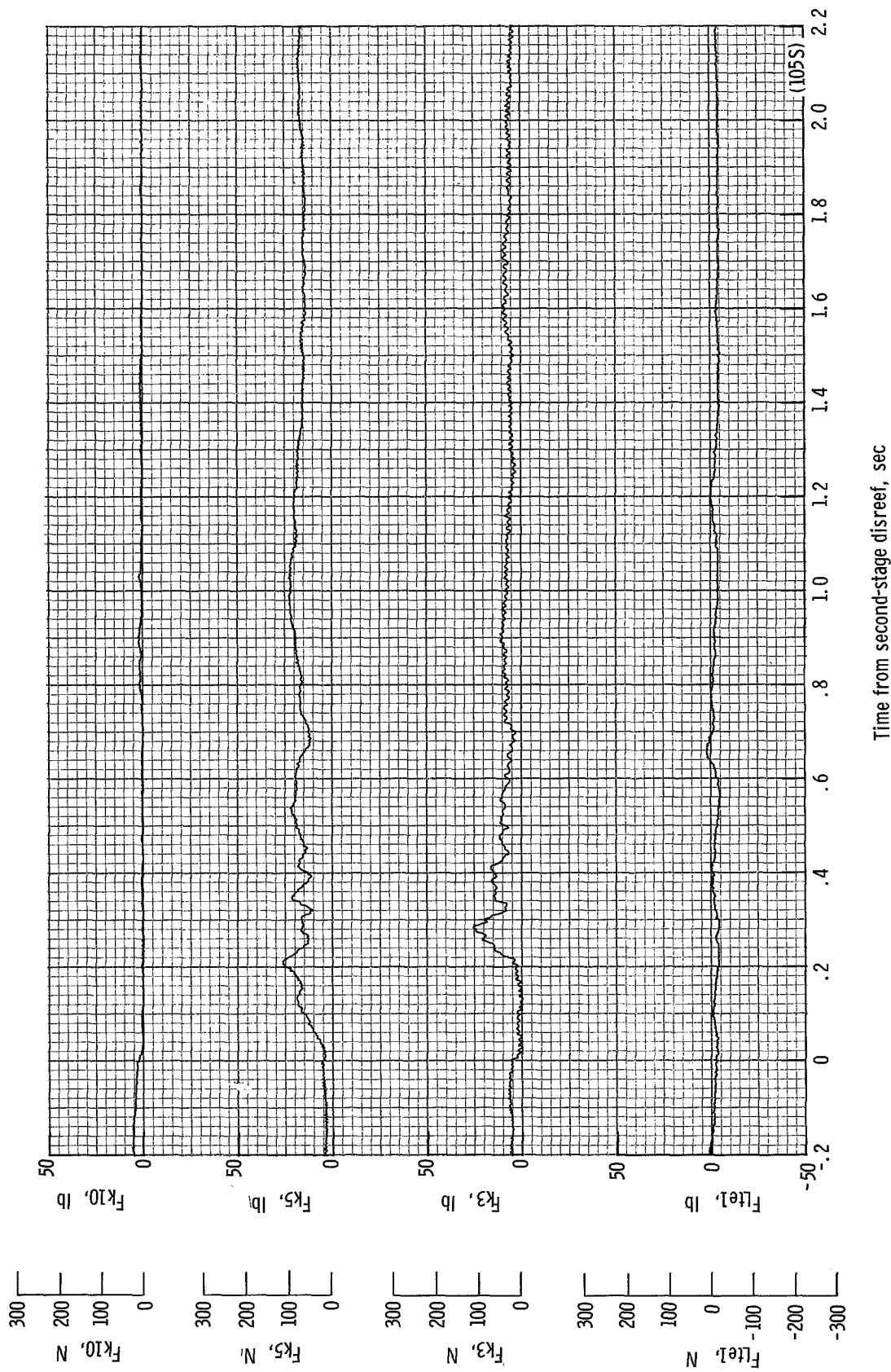
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 26.98 seconds after launch.

Figure 19.- Continued.



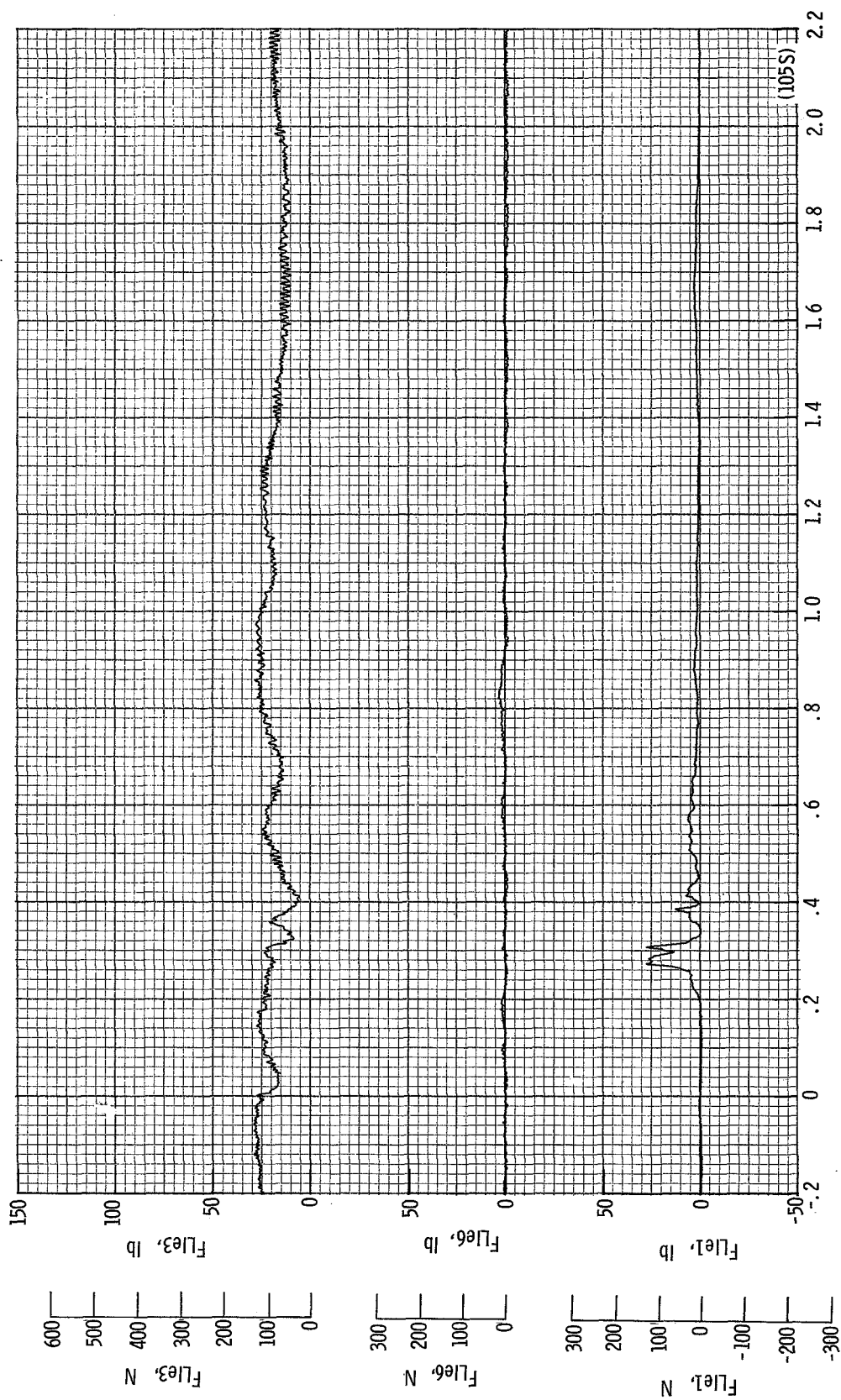
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 26.98 seconds after launch.

Figure 19.- Continued.



(k) Individual suspension-line loads F_{tel} , F_{k3} , F_{k5} , and F_{k10} plotted against time from second-stage disreef. Time = 0 second corresponds to 29.93 seconds after launch.

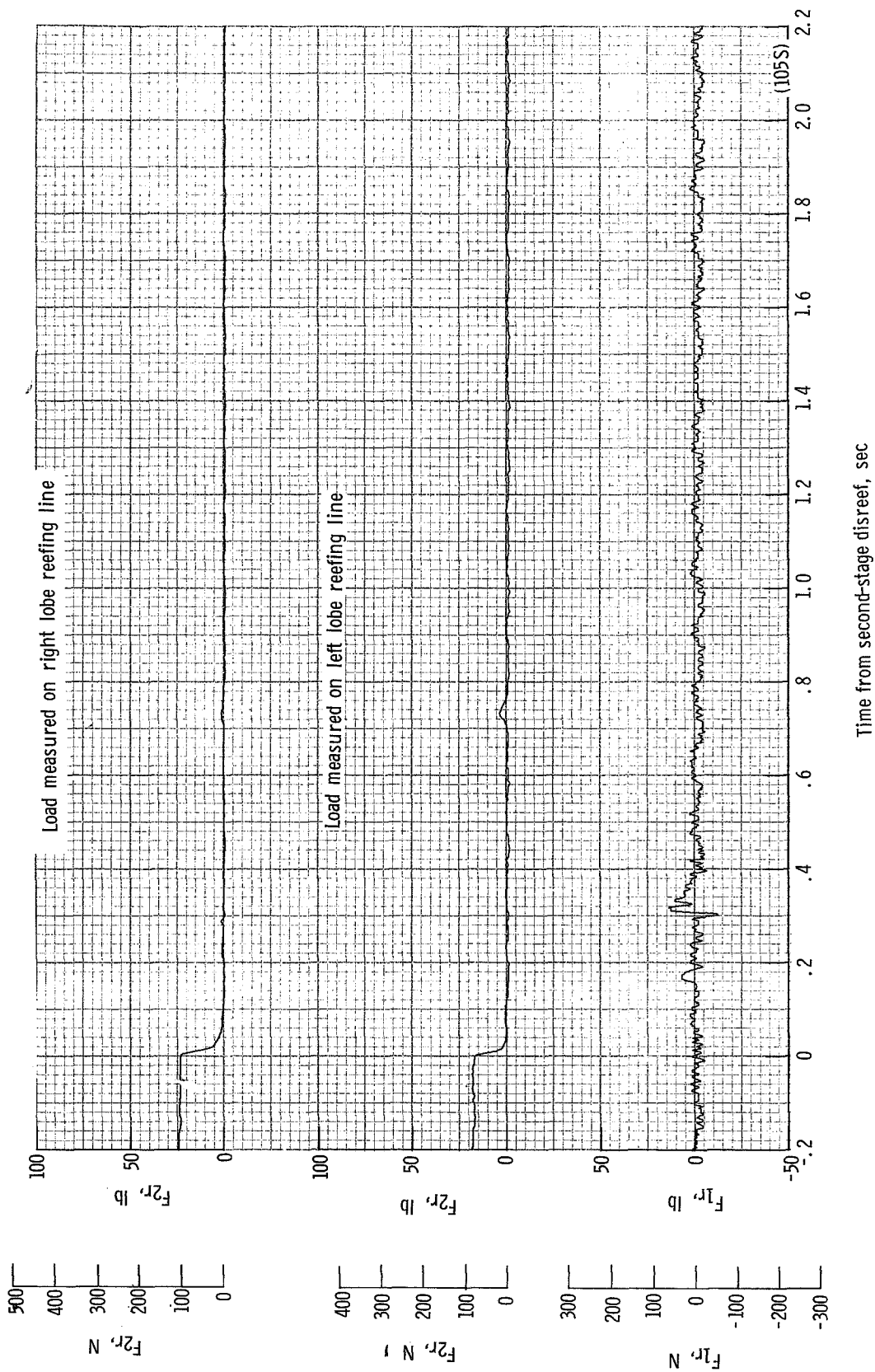
Figure 19.- Contin..ed.



Time from second-stage disreef, sec

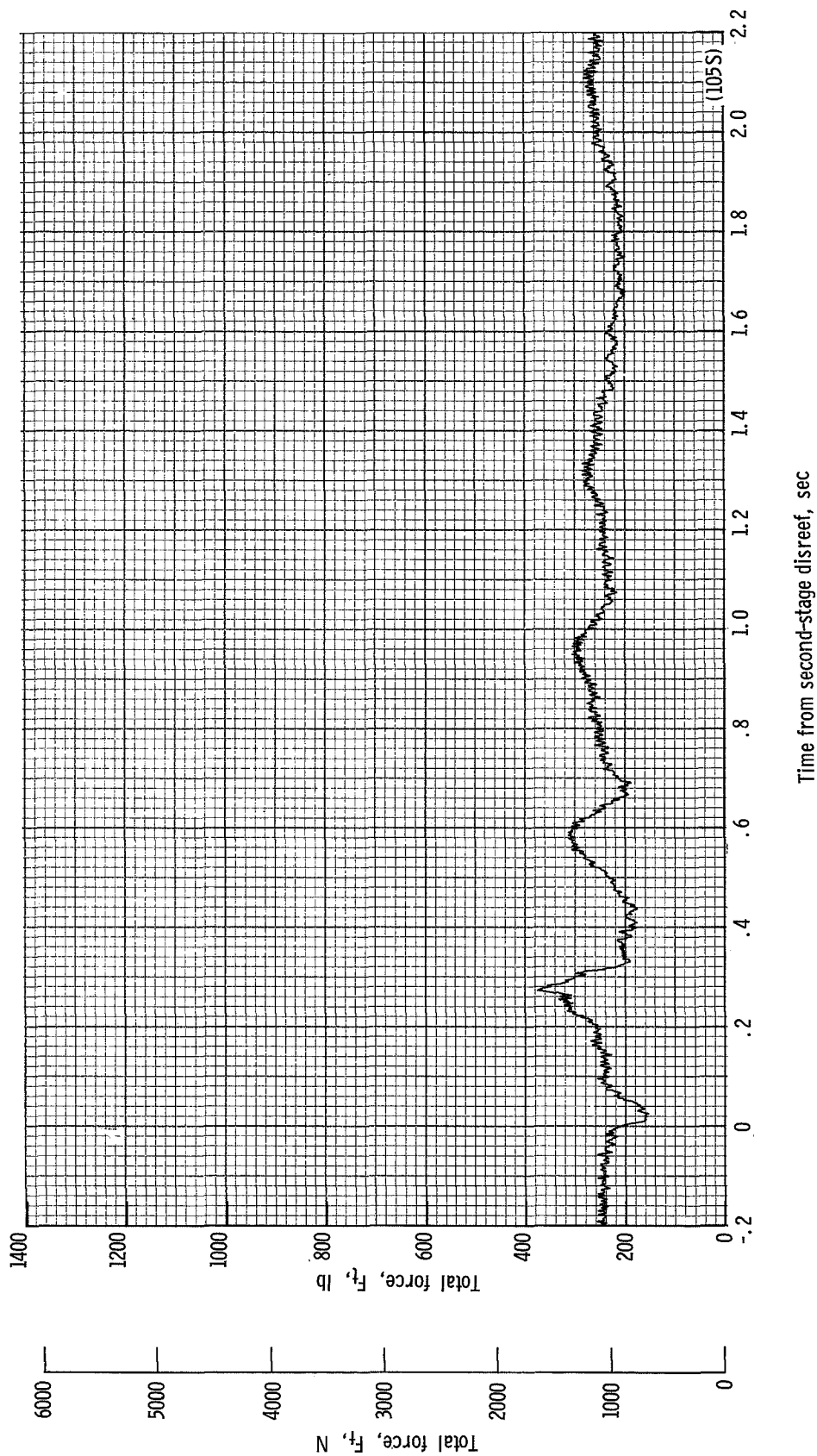
(1) Individual suspension-line loads F_{Lie1} , F_{Lie6} and F_{Lie3} plotted against time from second-stage disreef. Time = 0 second corresponds to 29.93 seconds after launch.

Figure 19.- Continued.



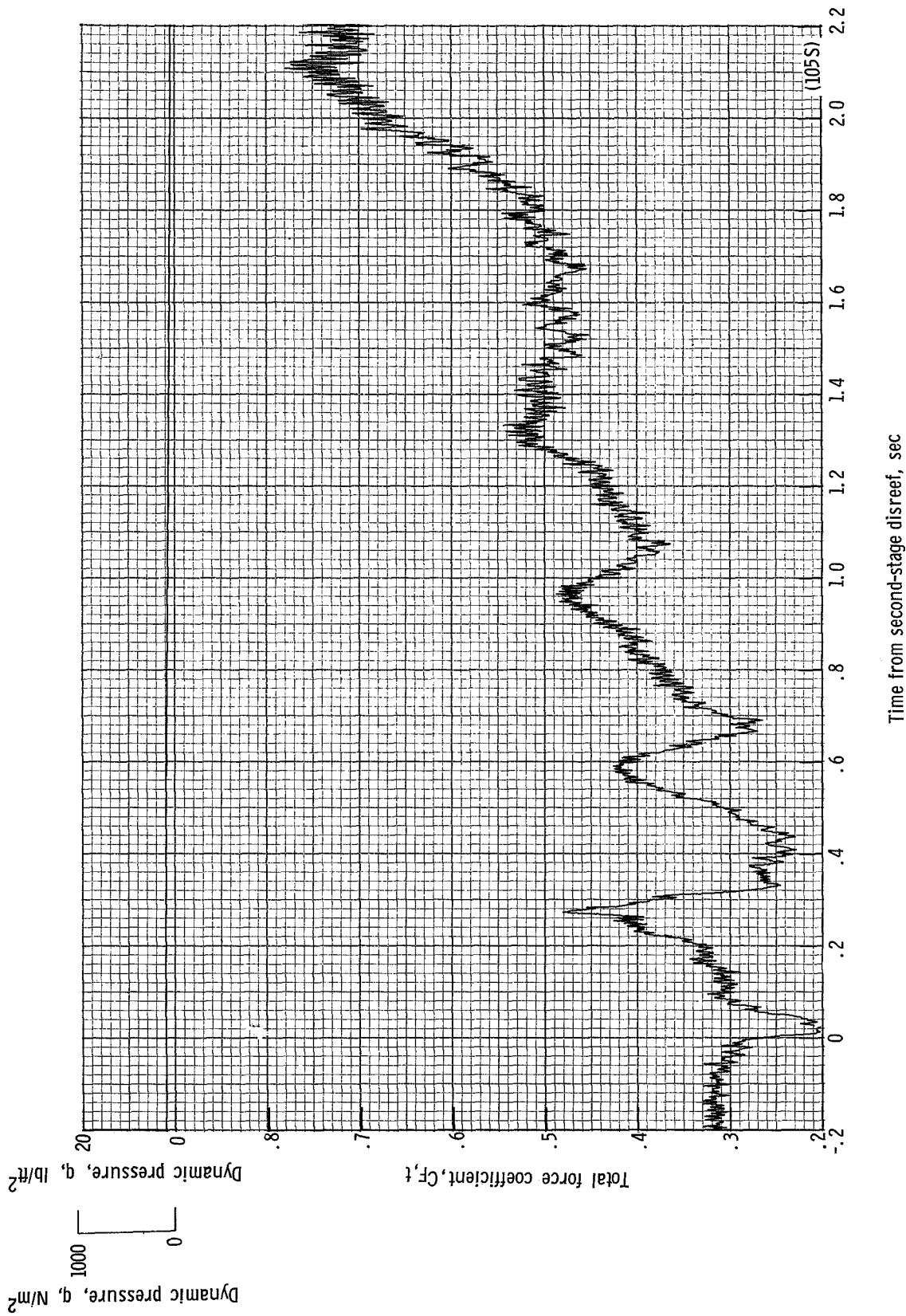
(m) Individual reefing-line loads F_{1r} and F_{2r} plotted against time from second-stage disreef. Time = 0 second corresponds to 29.93 seconds after launch.

Figure 19.- Continued.



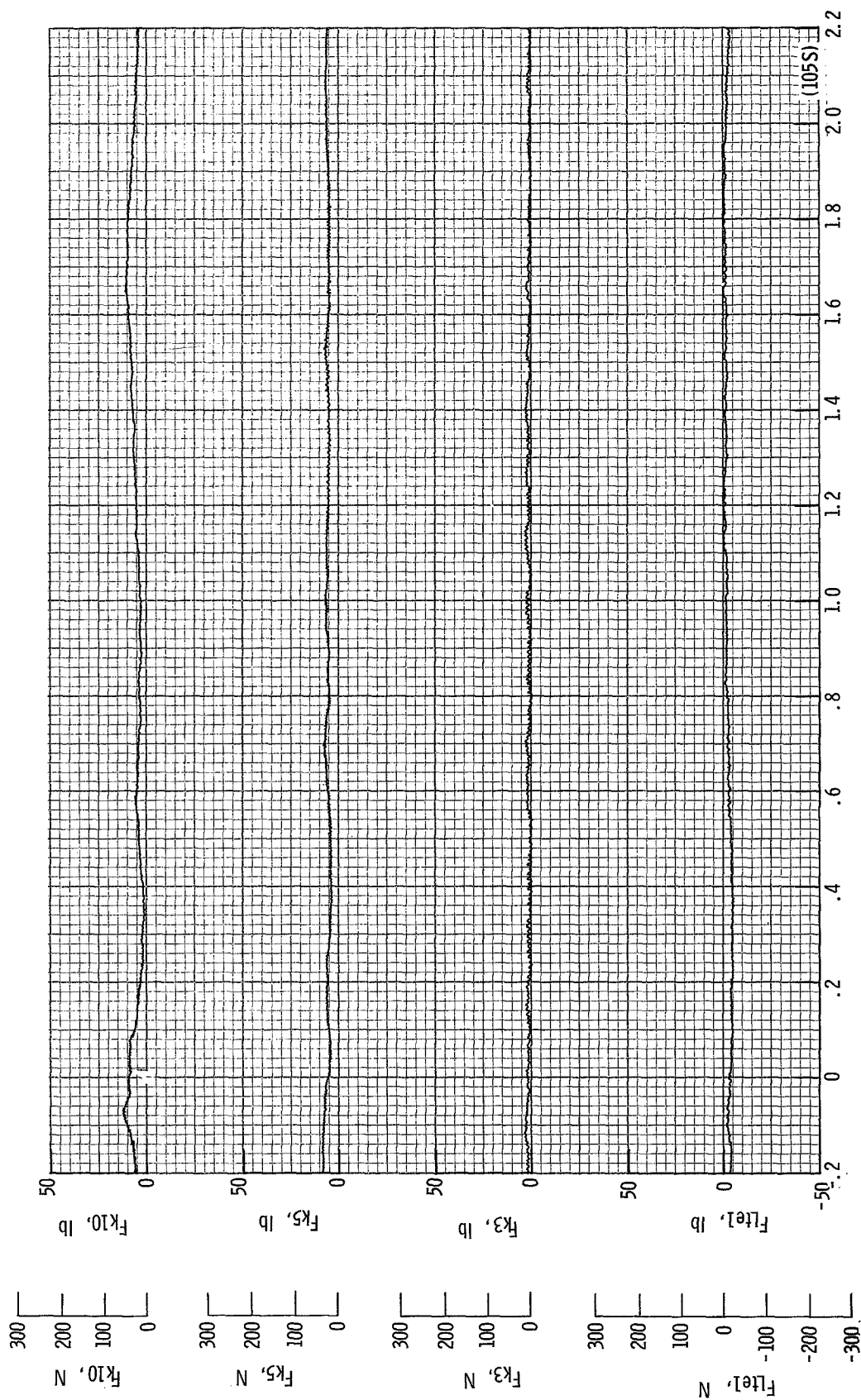
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 29.93 seconds after launch.

Figure 19.- Continued.



(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 29.93 seconds after launch.

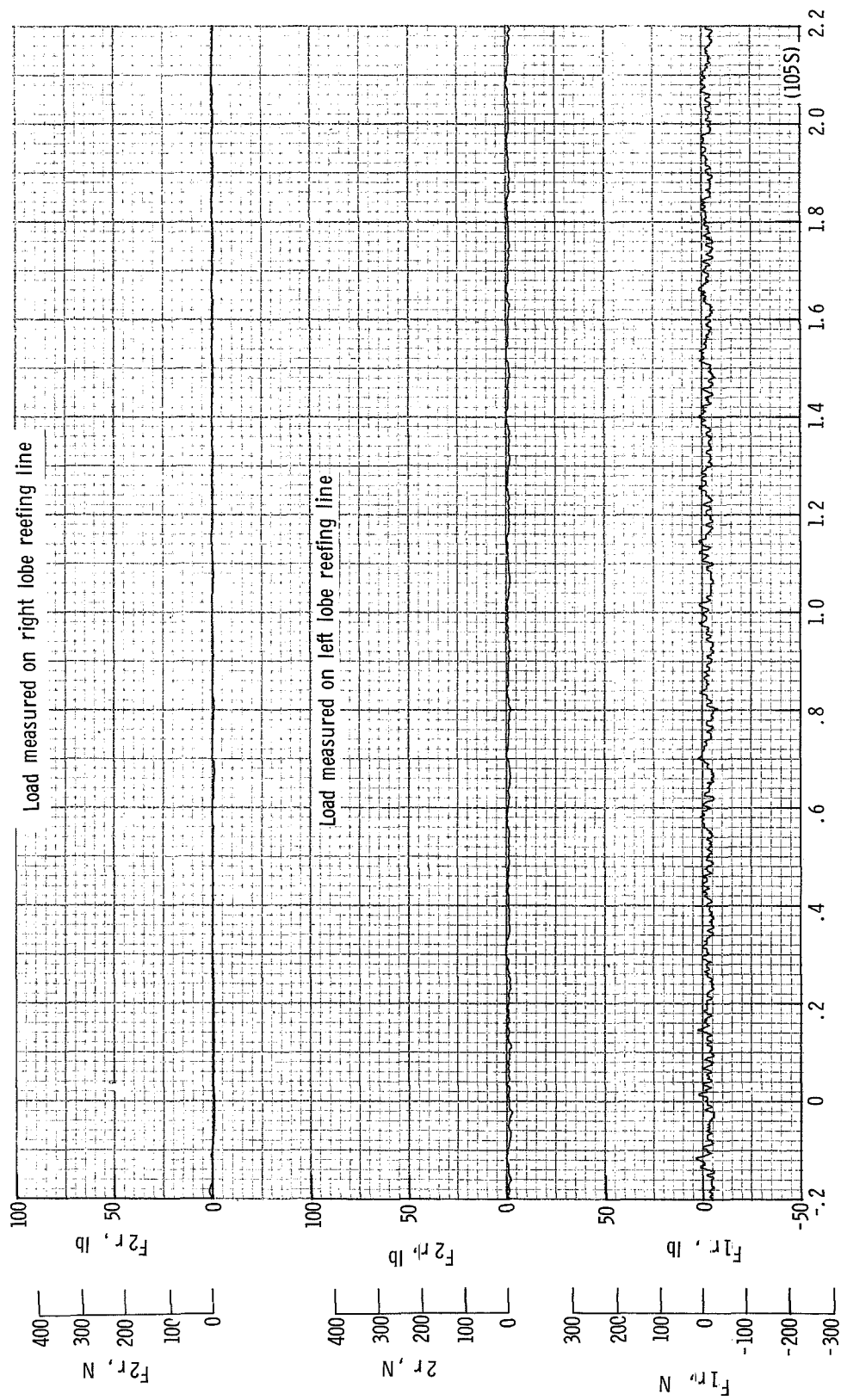
Figure 19.- Continued.



Time from third-stage disreef, sec

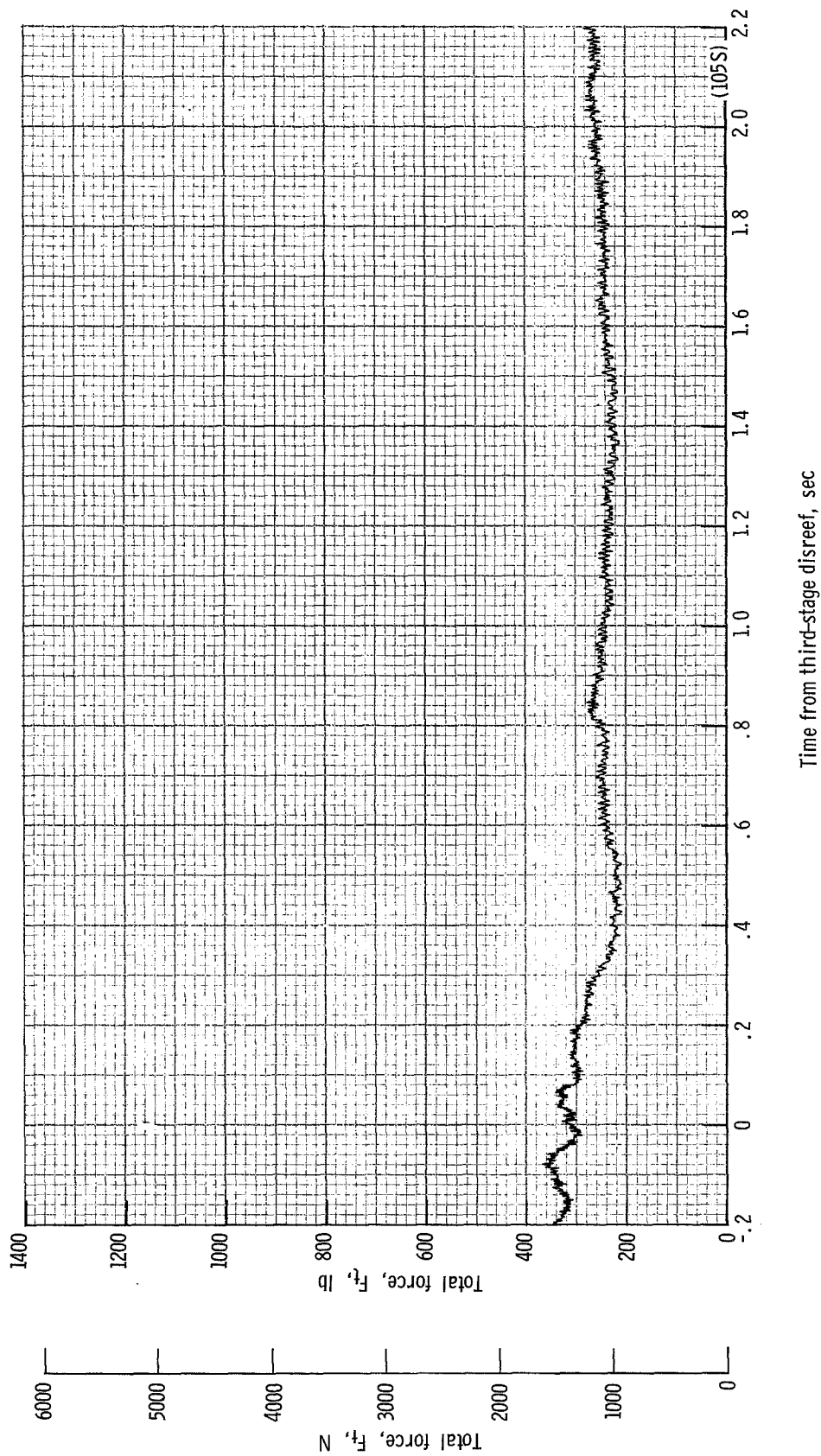
(p) Individual suspension-line loads F_{k1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from third-stage disreef. Time \approx 0 second corresponds to 34.39 seconds after launch.

Figure 19.- Continued.



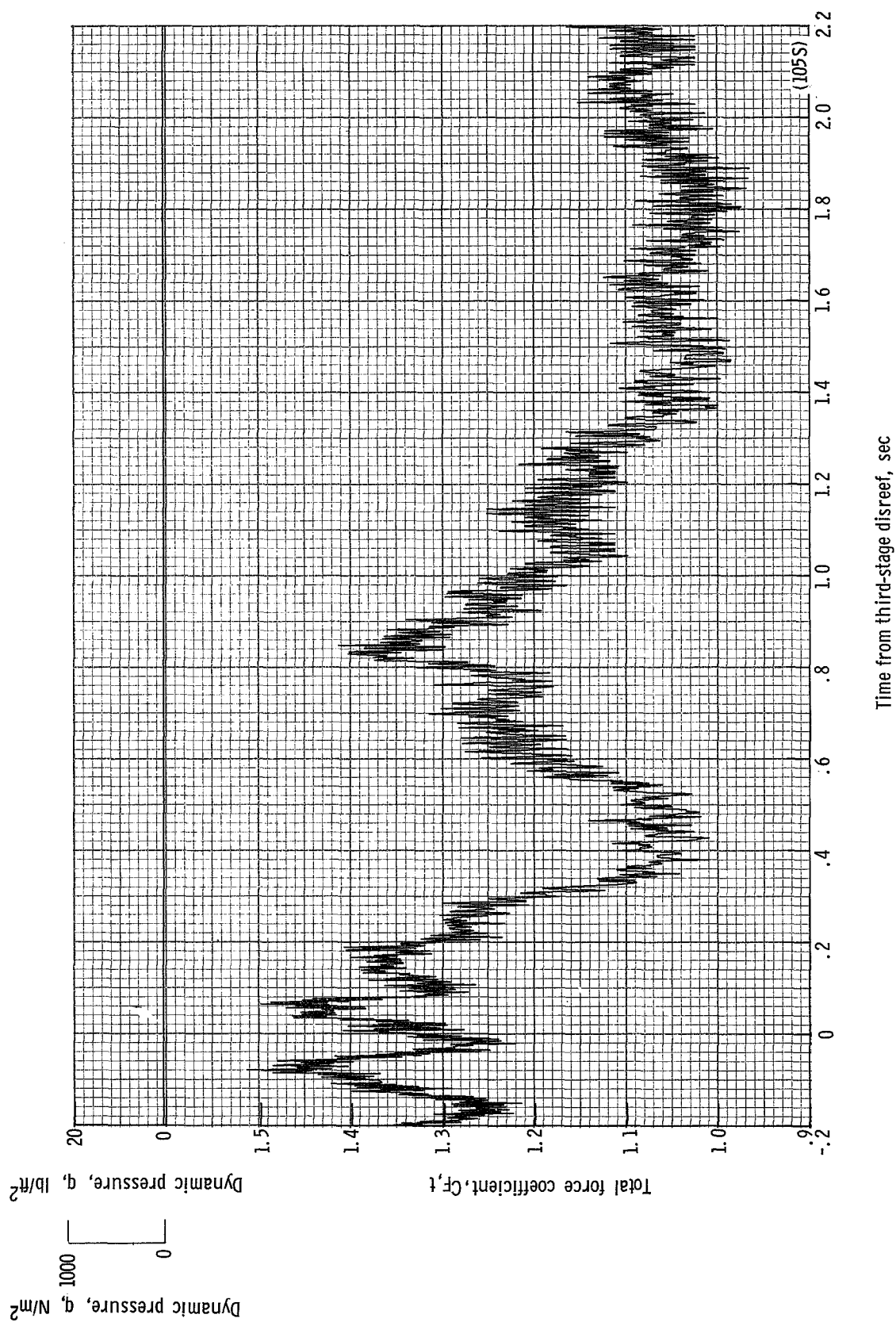
(r) Individual reefing-line loads F_{1r} and F_{2r} plotted against time from third-stage disreef. Time = 0 second corresponds to 34.39 seconds after launch.

Figure 19.- Continued.



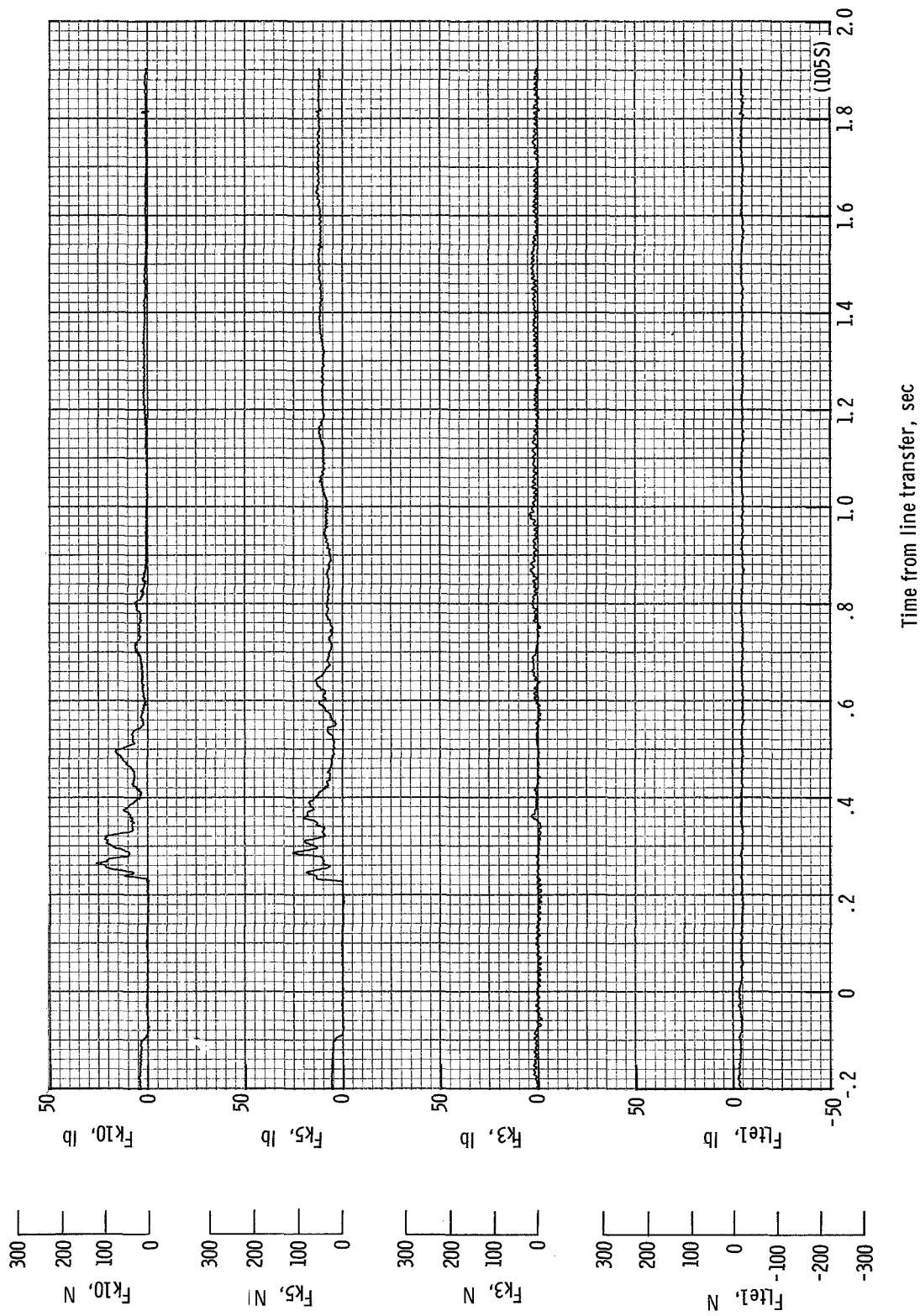
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 34.39 seconds after launch.

Figure 19.- Continued.



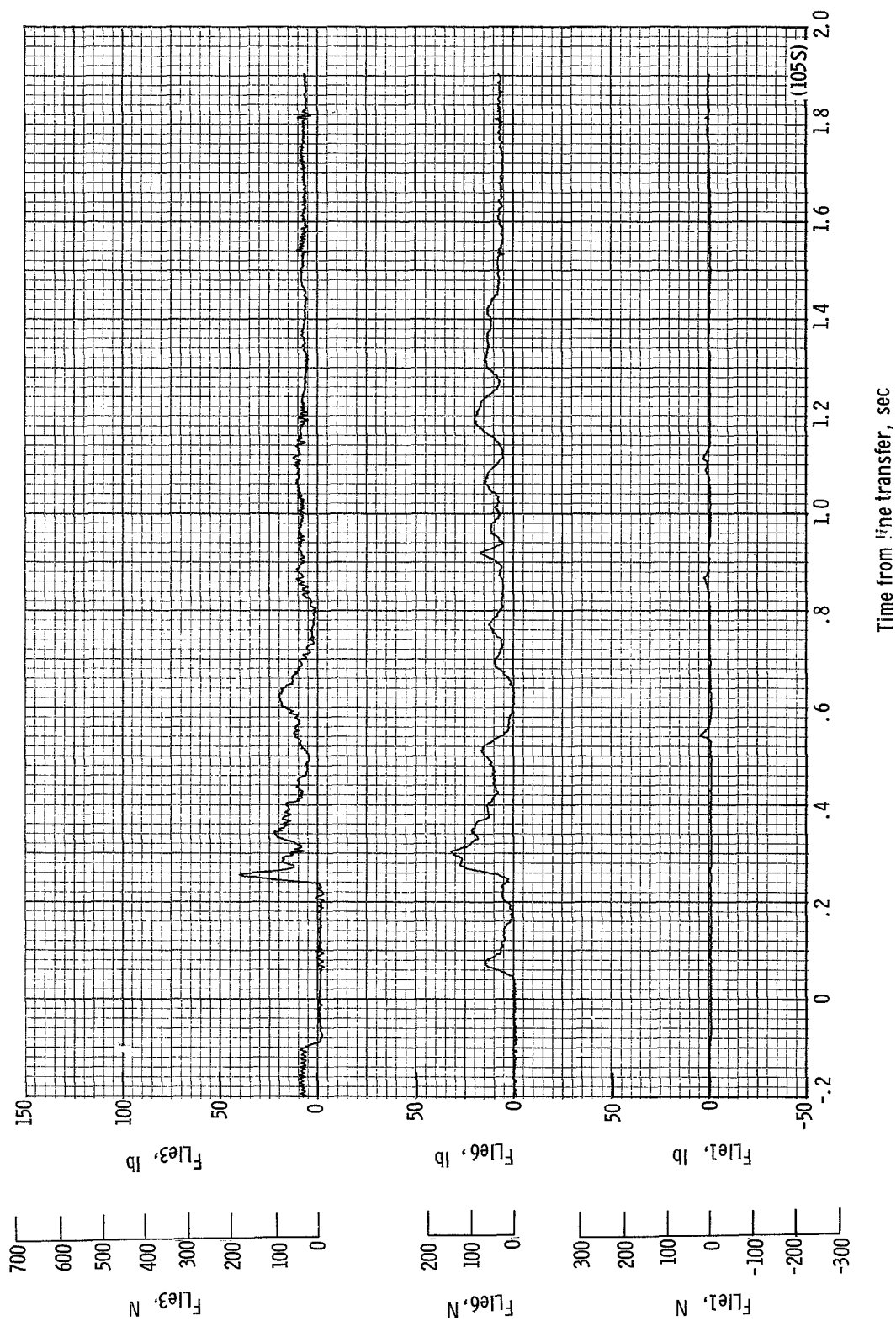
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 34.39 seconds after launch.

Figure 19.- Continued.



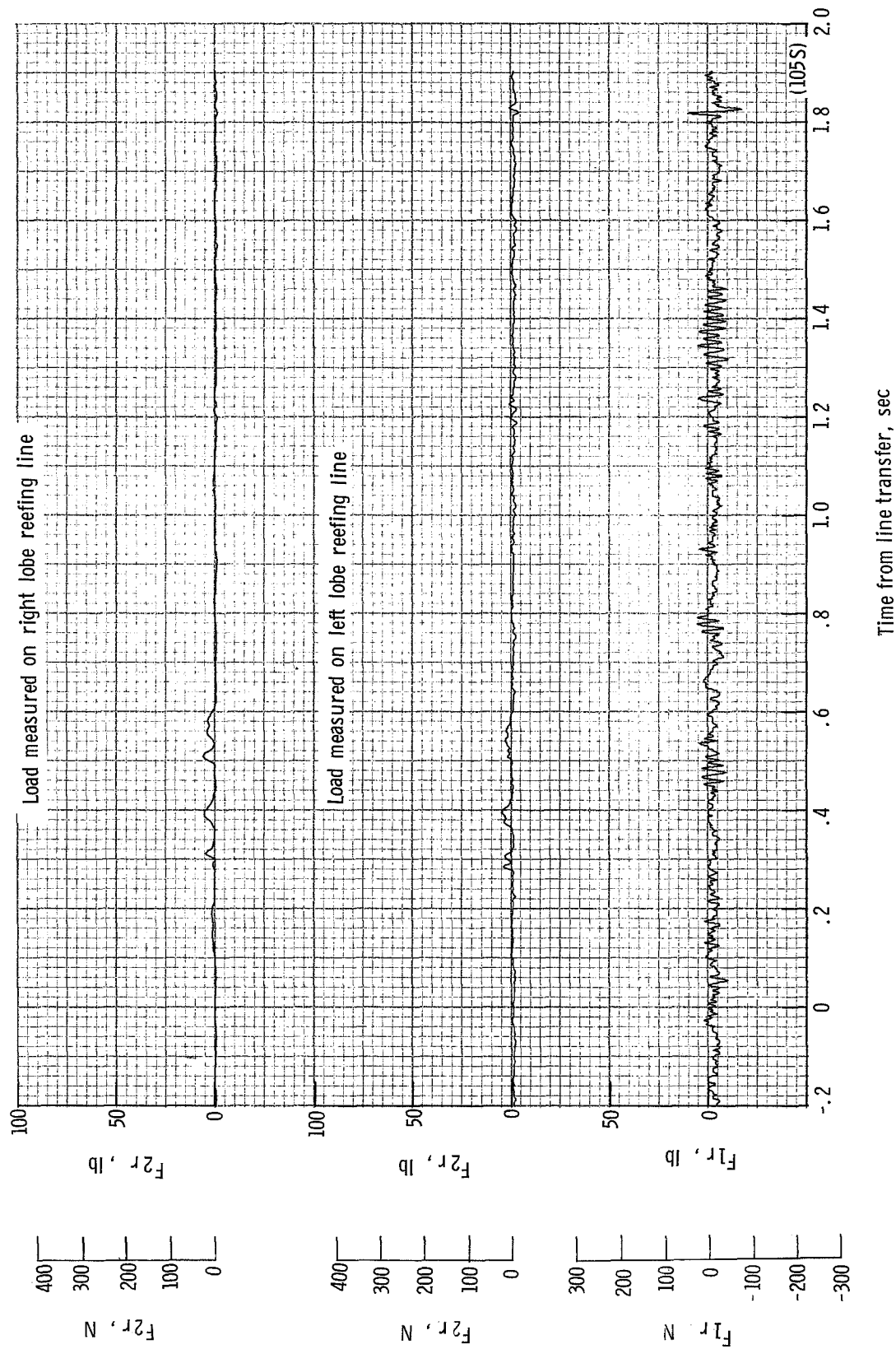
(u) Individual suspension-line loads F_{lte1} , F_{k3} , F_{k5} , and F_{k10} plotted against time from line transfer. Time = 0 second corresponds to 36.67 seconds after launch.

Figure 19.- Continued.



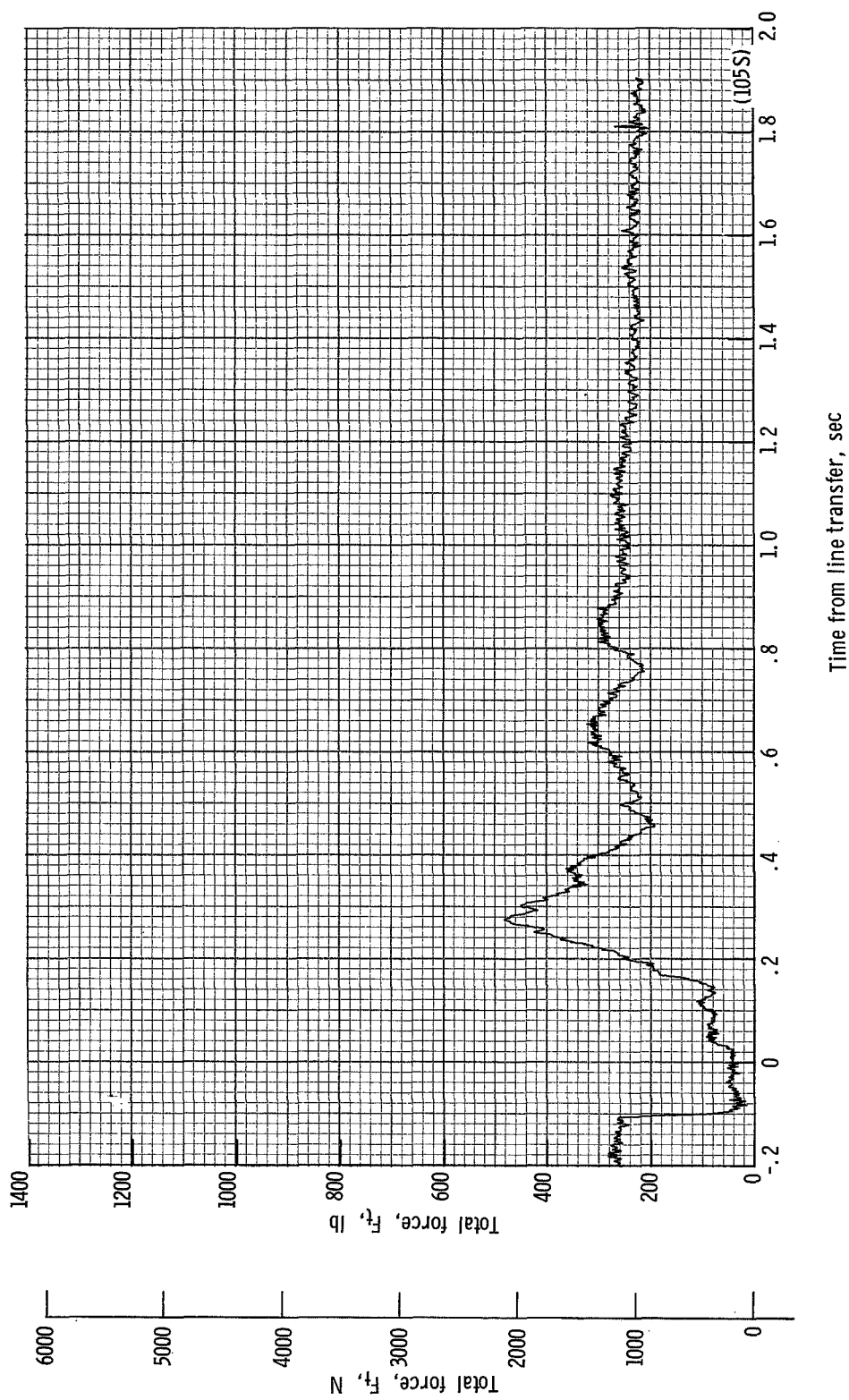
(v) Individual suspension-line loads F_{Le1} , F_{Le6} and F_{Le3} plotted against time from line transfer. Time = 0 second corresponds to 36.67 seconds after launch.

Figure 19.- Continued.



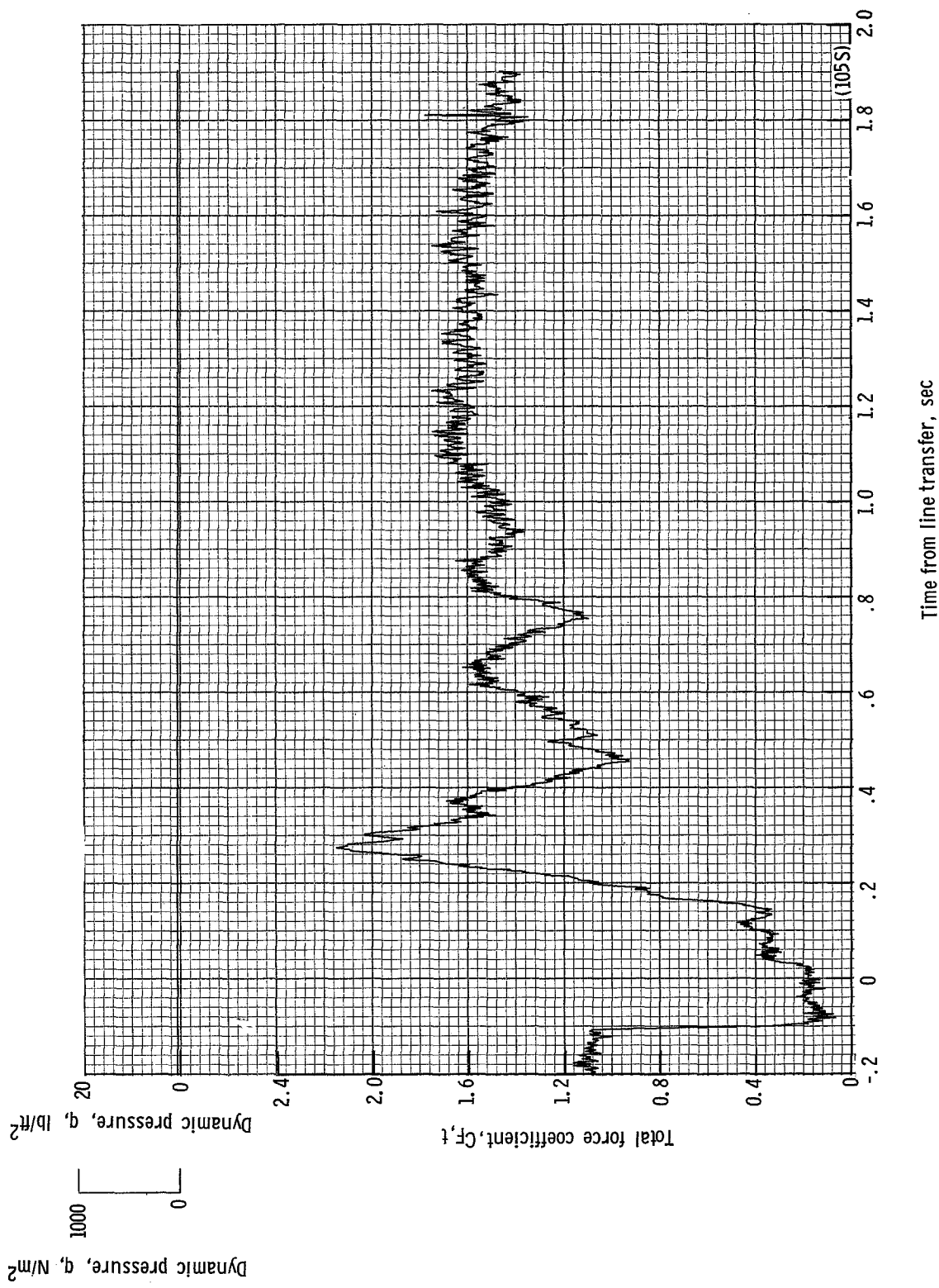
(w) Individual reefing-line loads F_{1r} and F_{2r} plotted against time from line transfer. Time = 0 second corresponds to 36.67 seconds after launch.

Figure 19.- Continued.



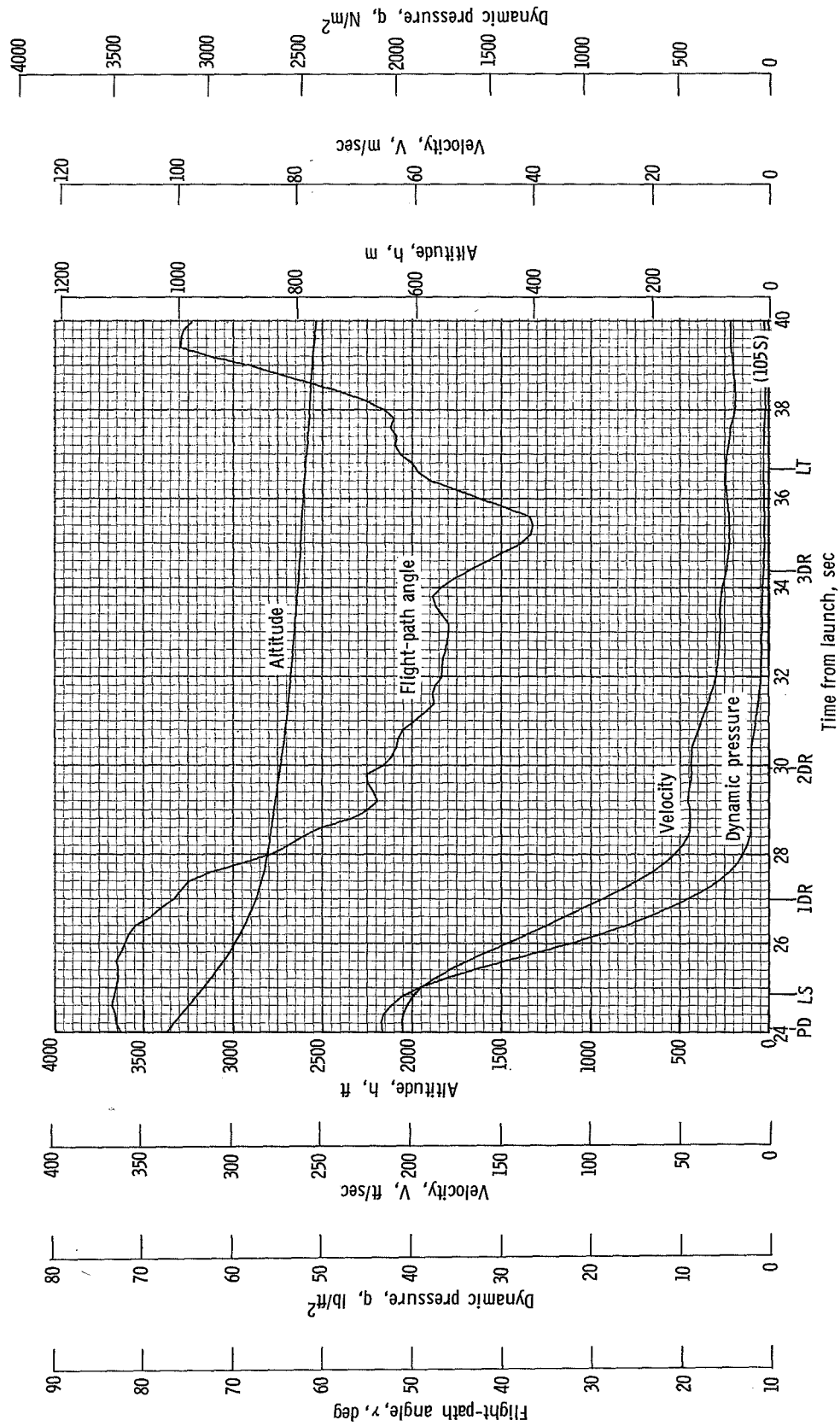
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 36.67 seconds after launch.

Figure 19.- Continued.



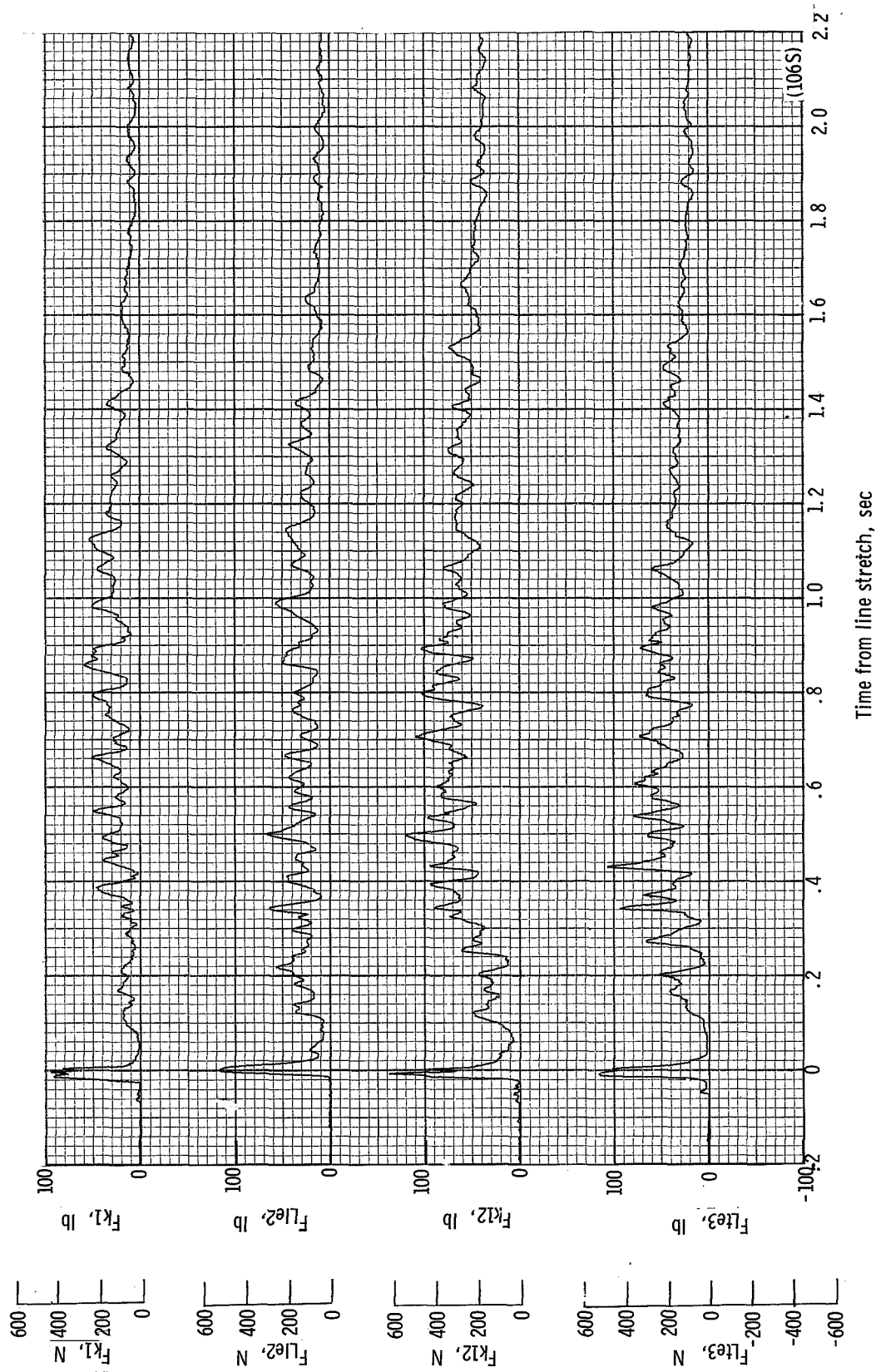
(v) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 36.67 seconds after launch.

Figure 19.- Continued.



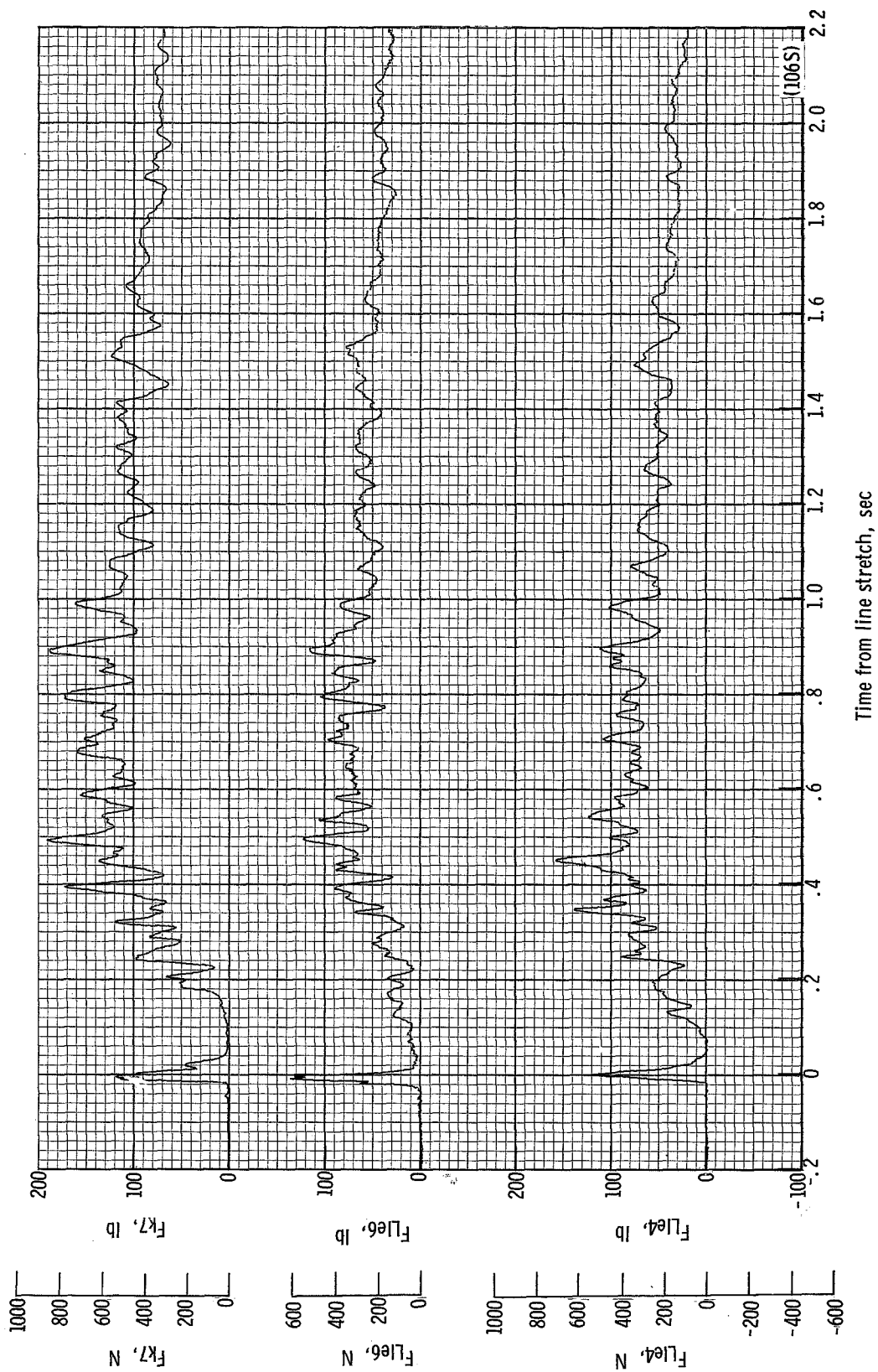
(z) Flight-path angle γ , dynamic pressure q , and velocity V , and altitude h plotted against time from launch.

Figure 19.- Concluded.



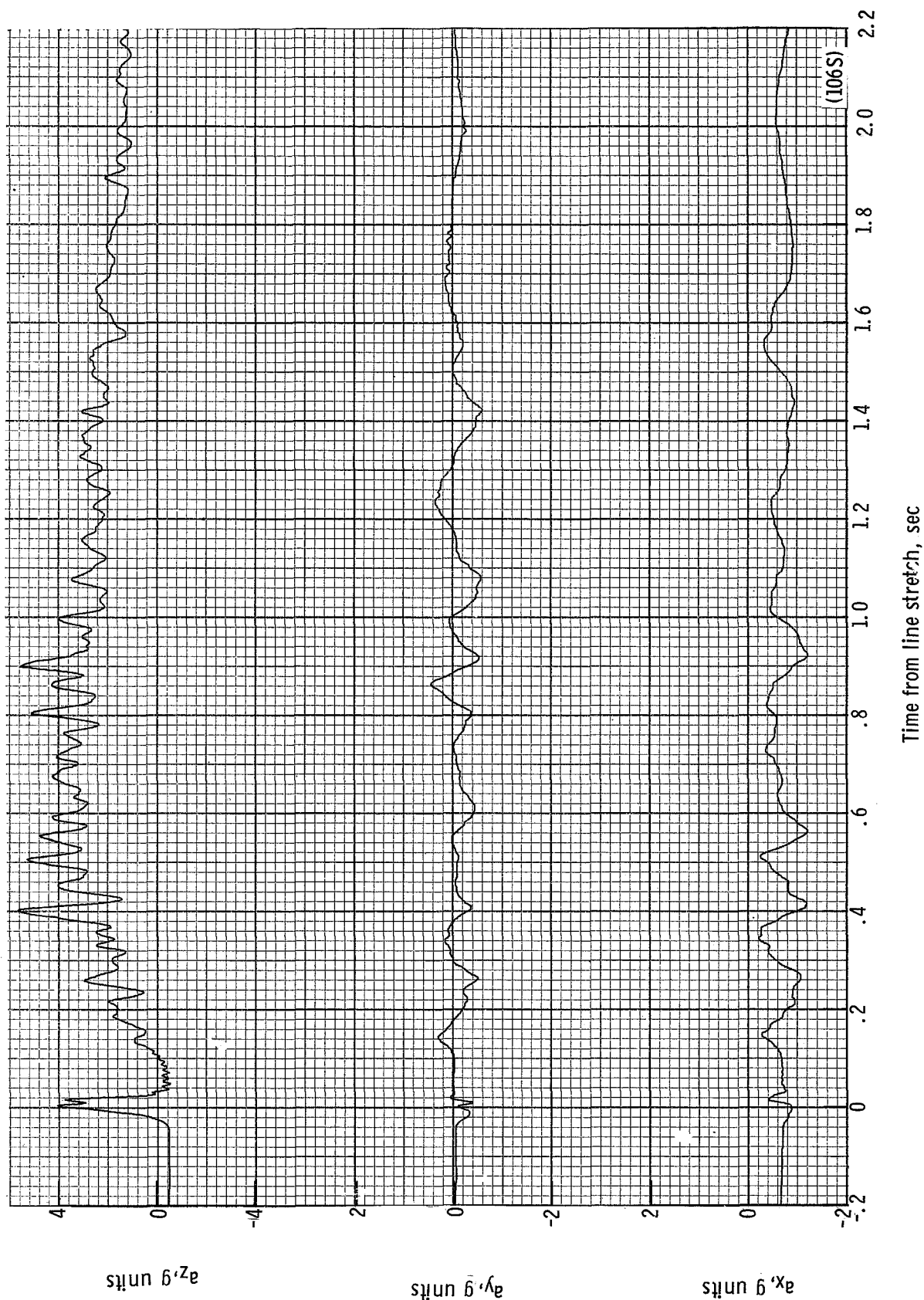
(a) Individual suspension-line loads F_{te3} , F_{k12} , F_{k2} , and F_{k1} plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 20.- Time history of single-keel parawing deployment data for test 106S. $W_D = 2225.4$ N (500.3 lb); $W_P = 2088.4$ N (469.5 lb); $q_{PD} = 3786.2$ N/m² (78.7 lb/ft²); $h_{PD} = 5778$ m (18 956 ft); $t_r/t_k = 0.116$; reefing version 11.

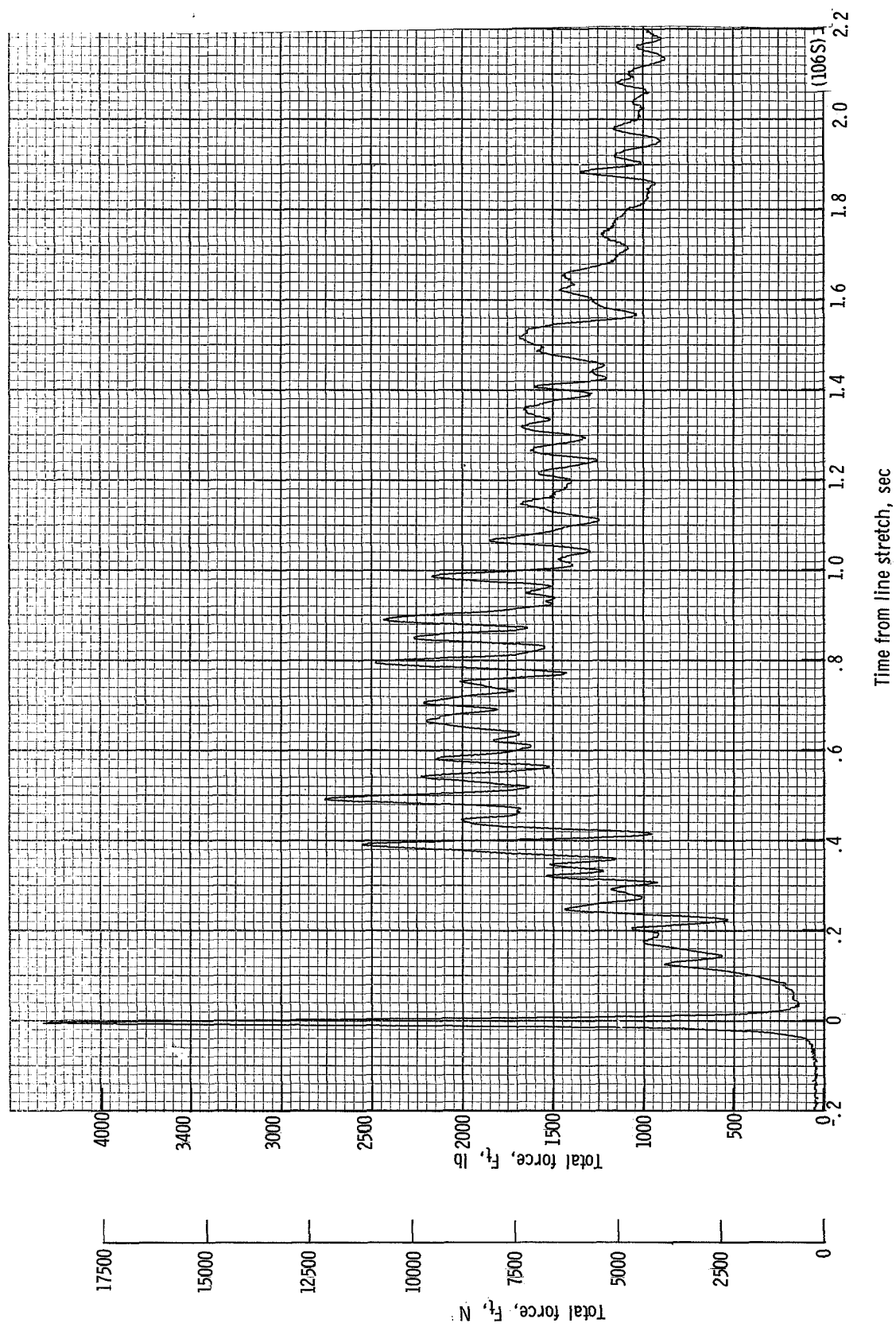


(b) Individual suspension-line loads $F_{L_{ie4}}$, $F_{L_{ie6}}$ and F_{k7} plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 20.- Continued.

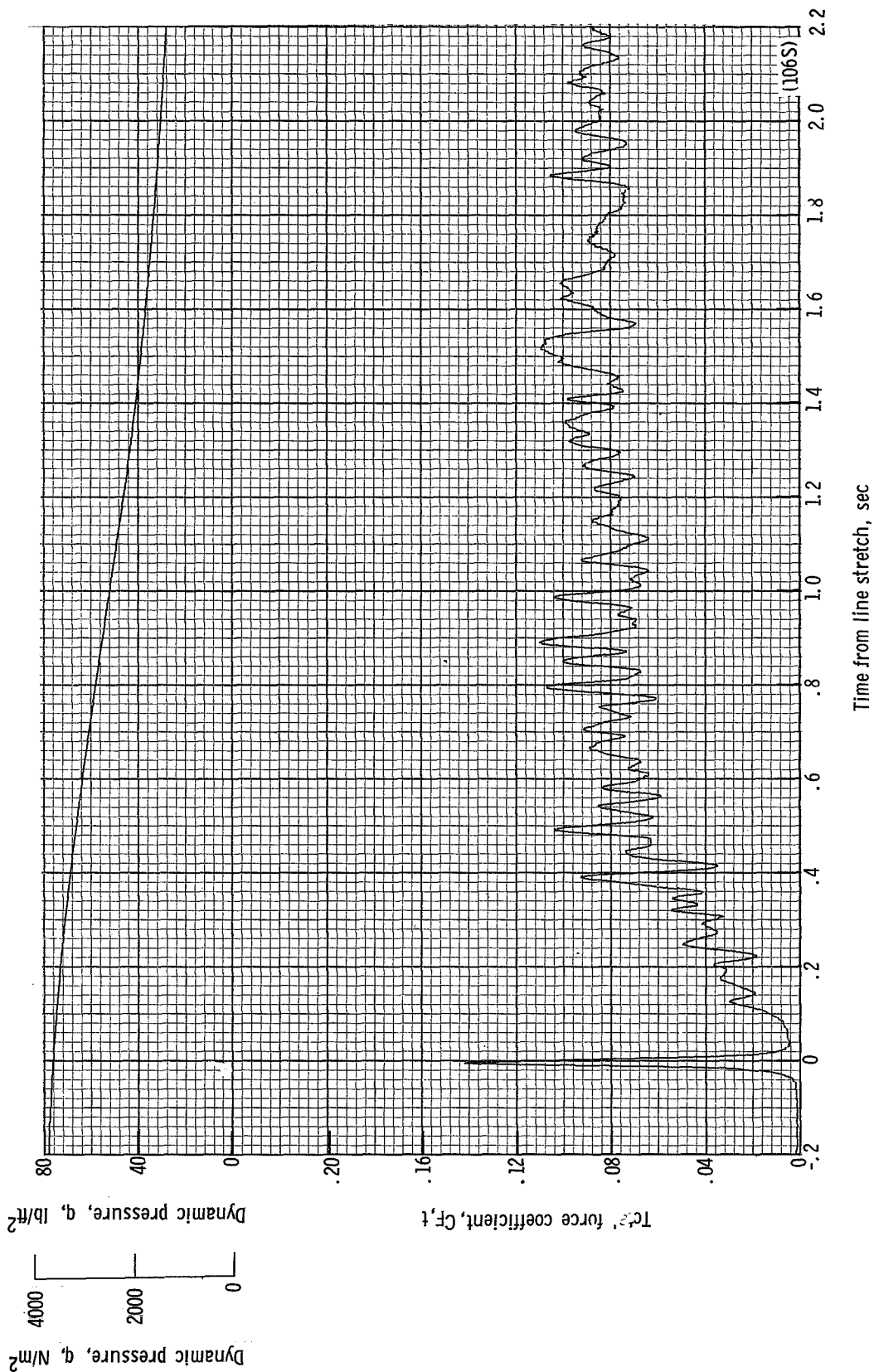


(c) Accelerations a_x , a_y , and a_z plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.
Figure 20.- Continued.



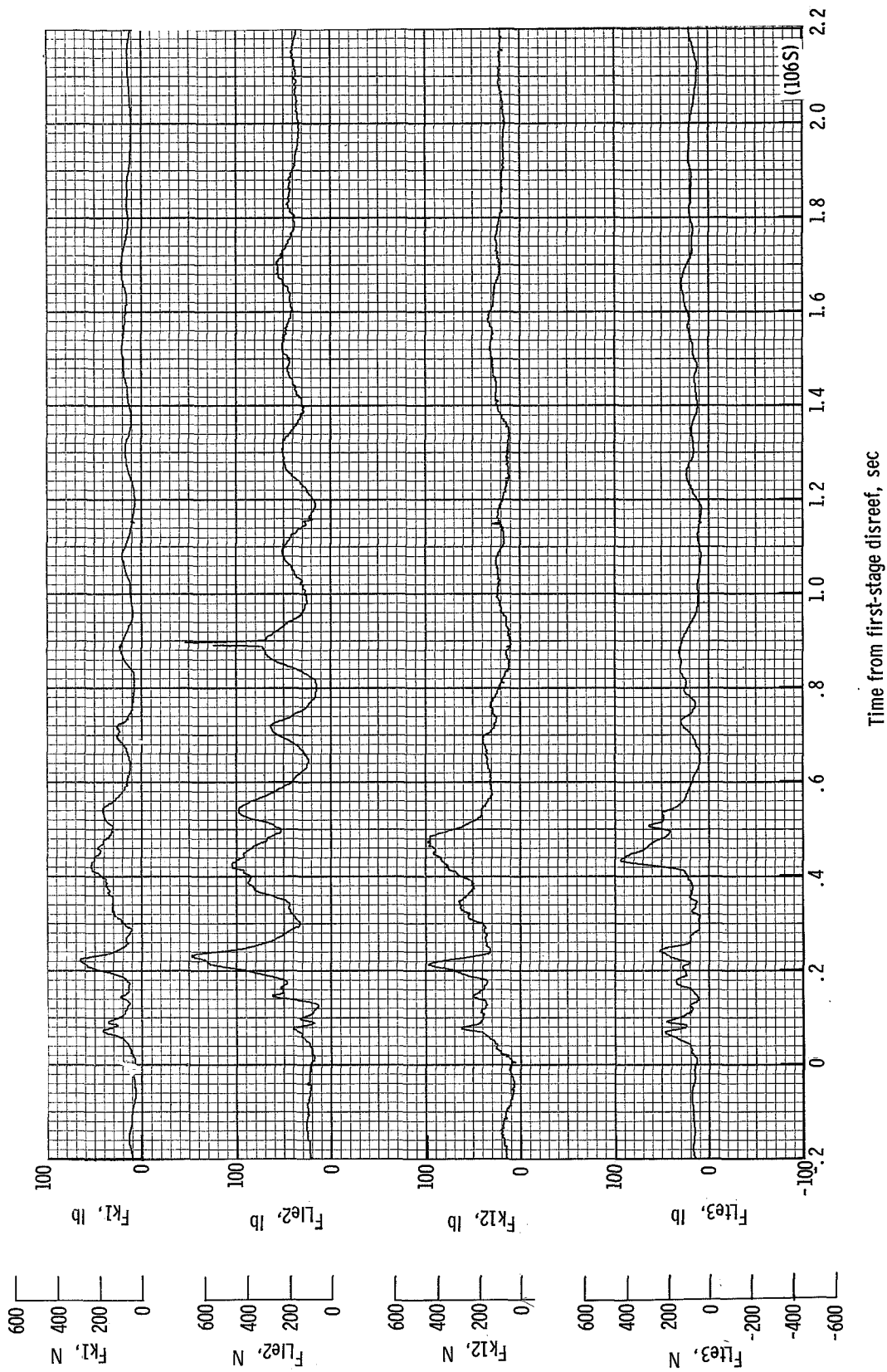
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 20.- Continued.



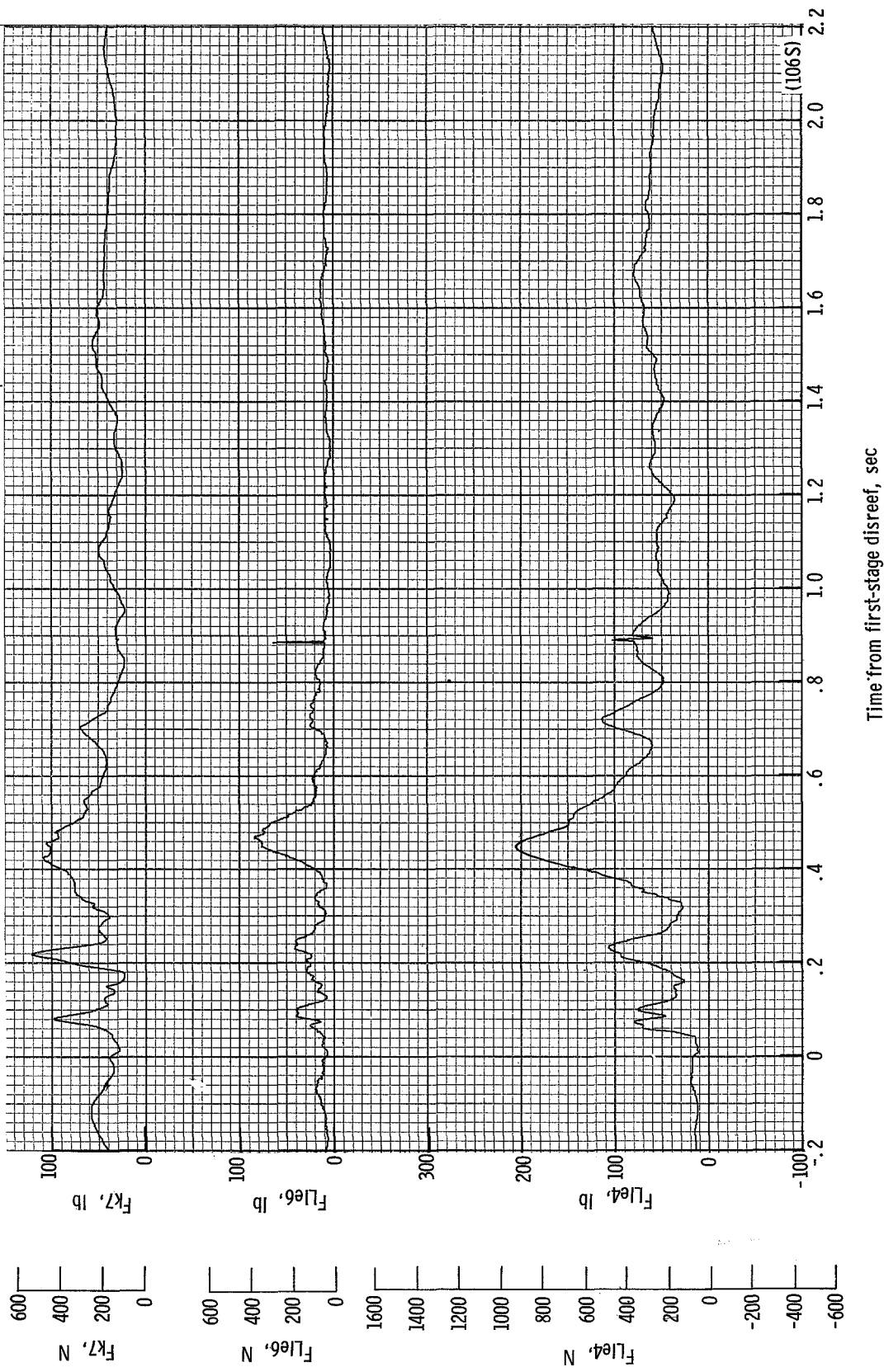
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 20.- Continued.



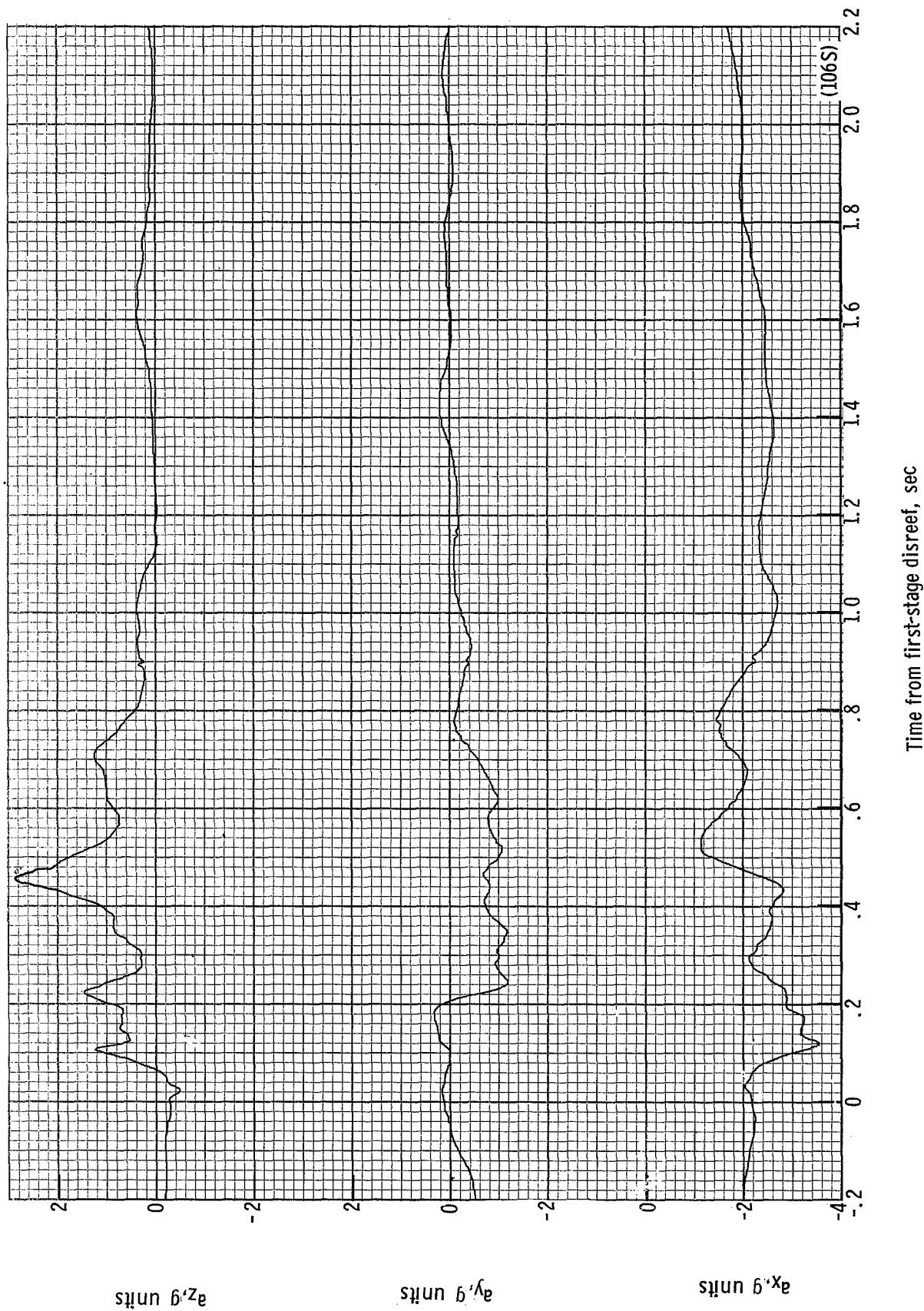
(f) Individual suspension-line loads F_{Lte3} , F_{K12} , F_{Lte2} , and F_{K1} plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 20.- Continued.



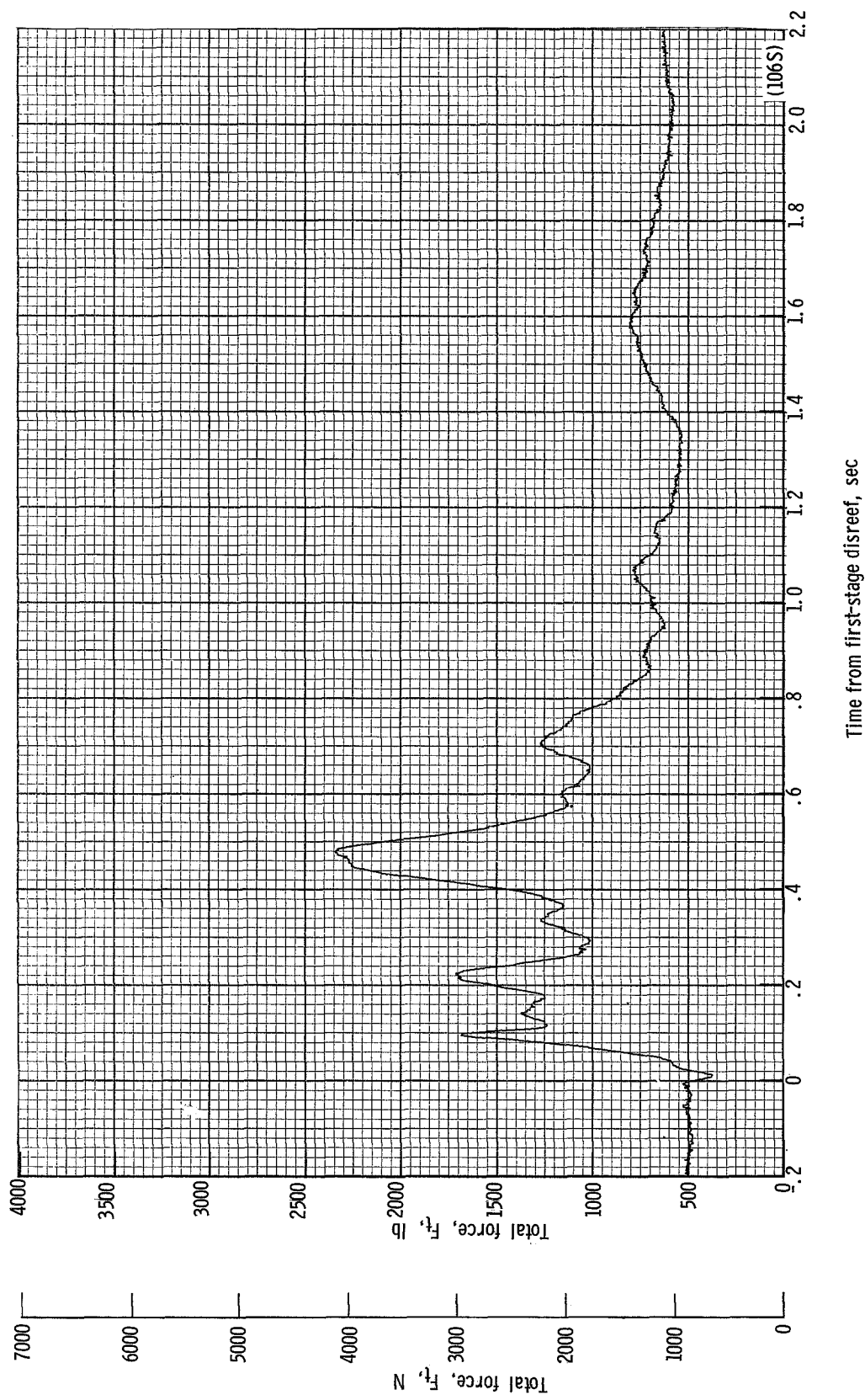
(g) Individual suspension-line loads F_{Lie4} , F_{Lie6} , and F_{K7} plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 20.- Continued.



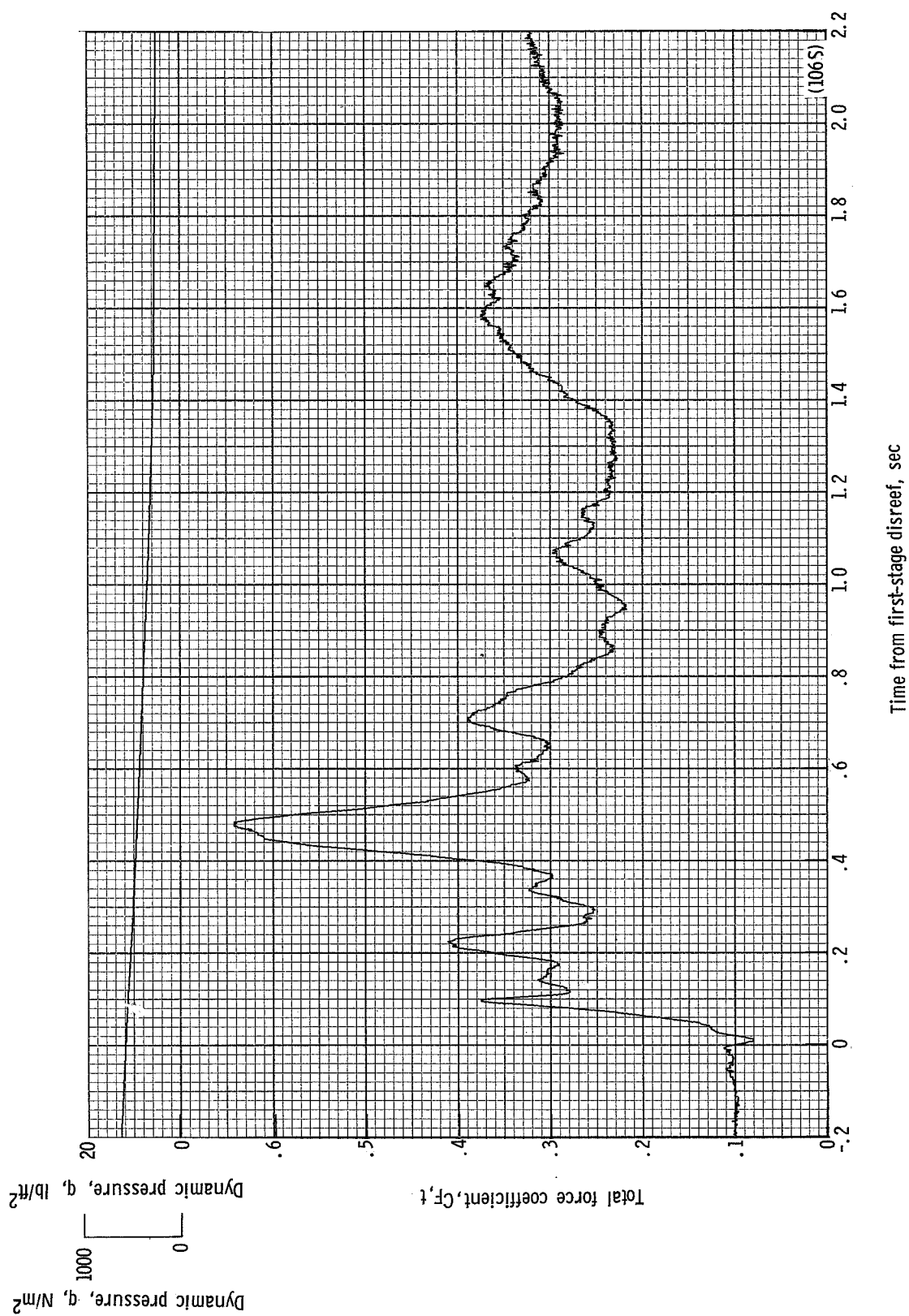
(h) Accelerations a_x , a_y , and a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 20.- Continued.



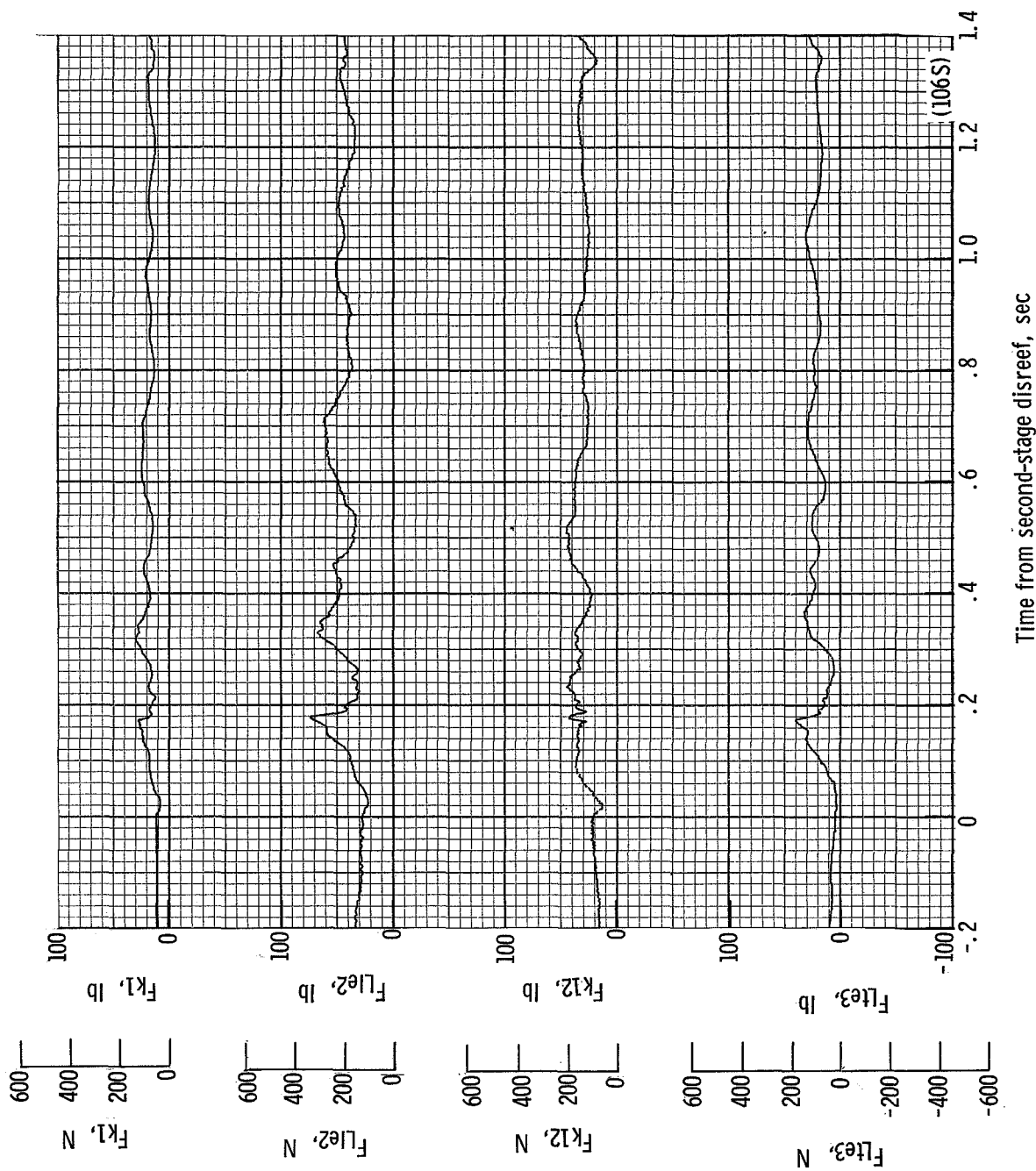
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 20.- Continued.



(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

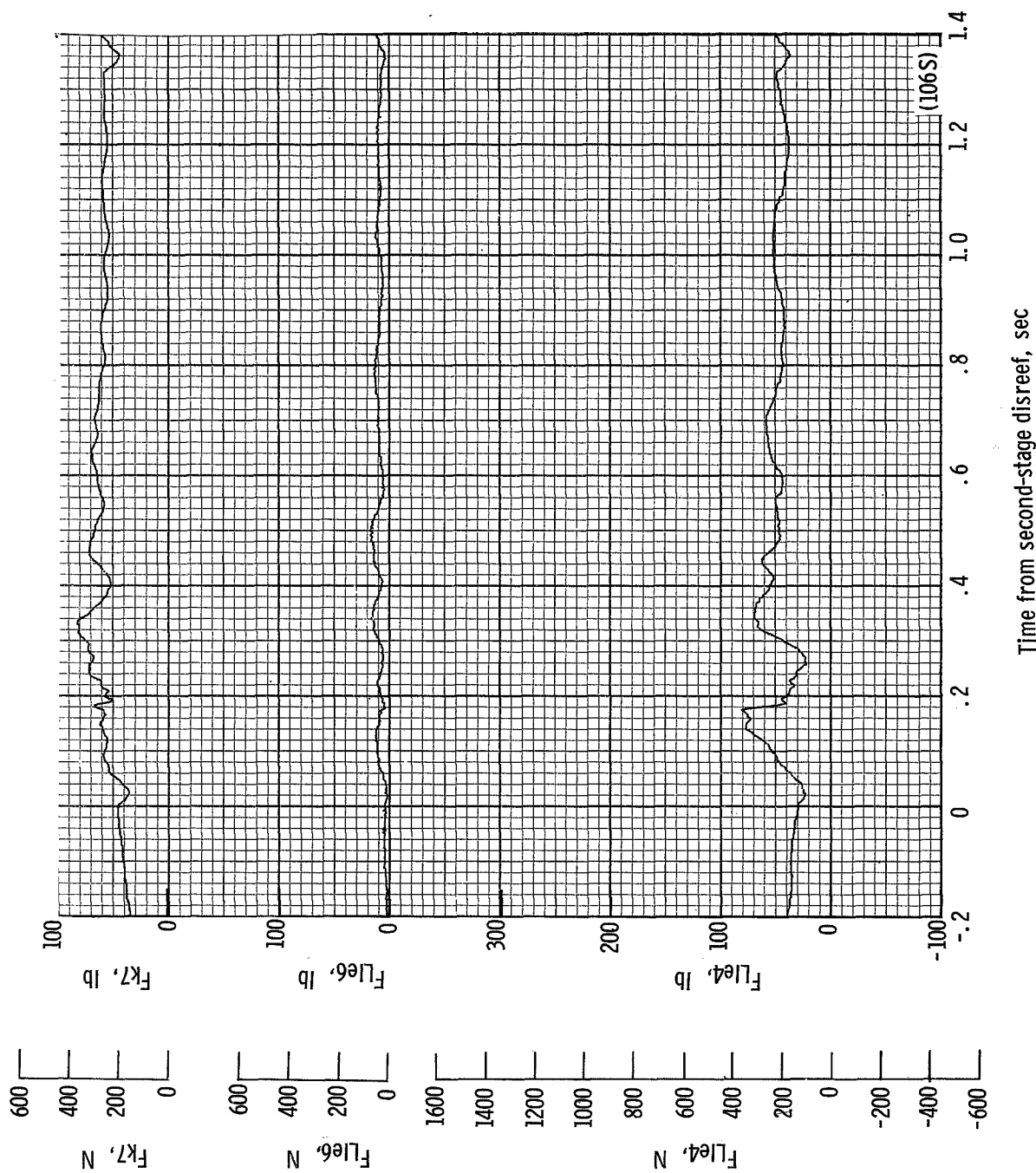
Figure 20.- Continued.



Time from second-stage disreef, sec

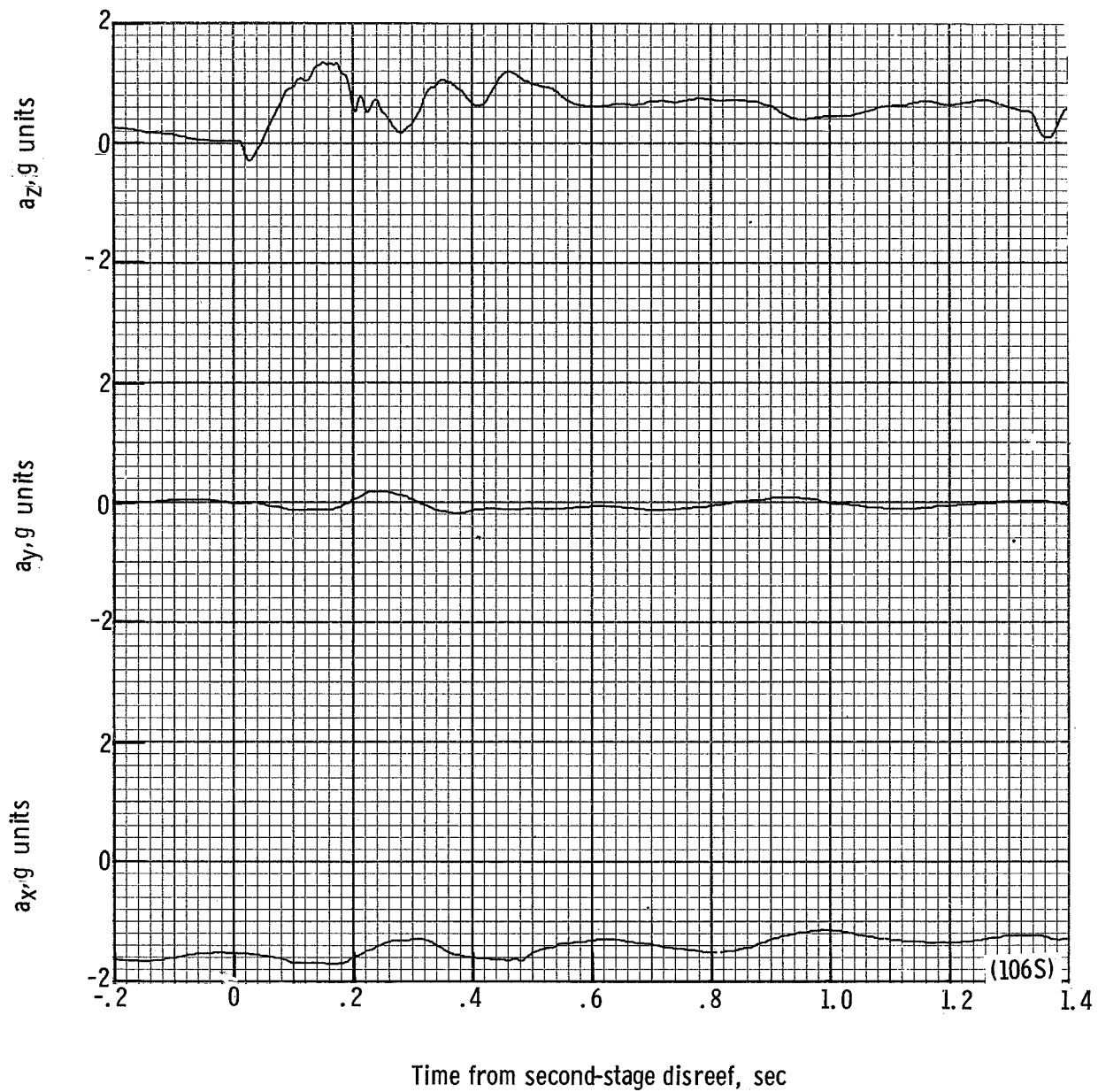
(k) Individual suspension-line loads F_{lte3} , F_{k12} , F_{lte2} , and F_{k1} plotted against time from second-stage disreef. Time = 0 second corresponds to 40.06 seconds after launch.

Figure 20.- Continued.



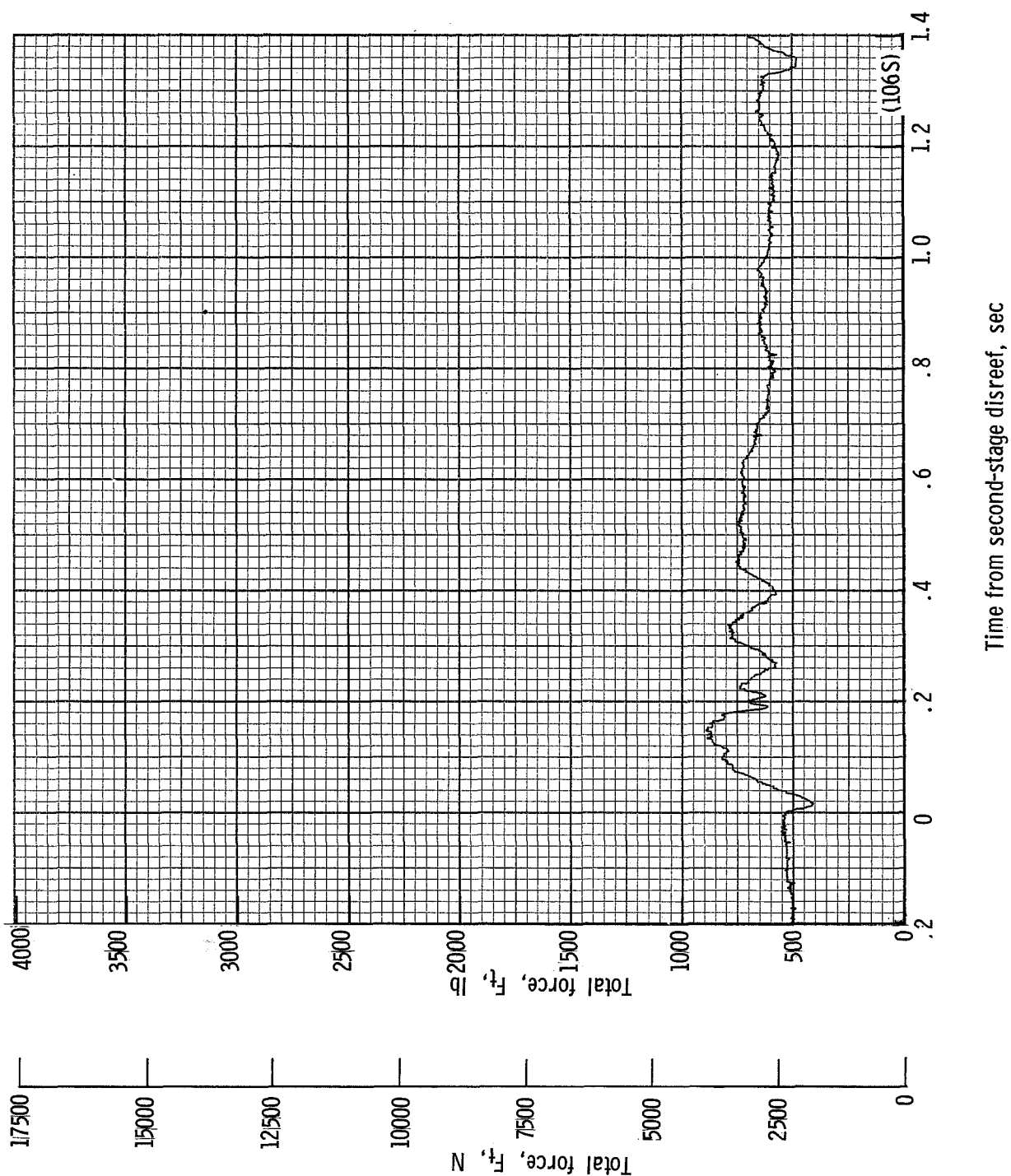
(1) Individual suspension-line loads F_{L4} , F_{L6} and F_{K7} plotted against time from second-stage disreef. Time = 0 second corresponds to 40.06 seconds after launch.

Figure 20.- Continued.



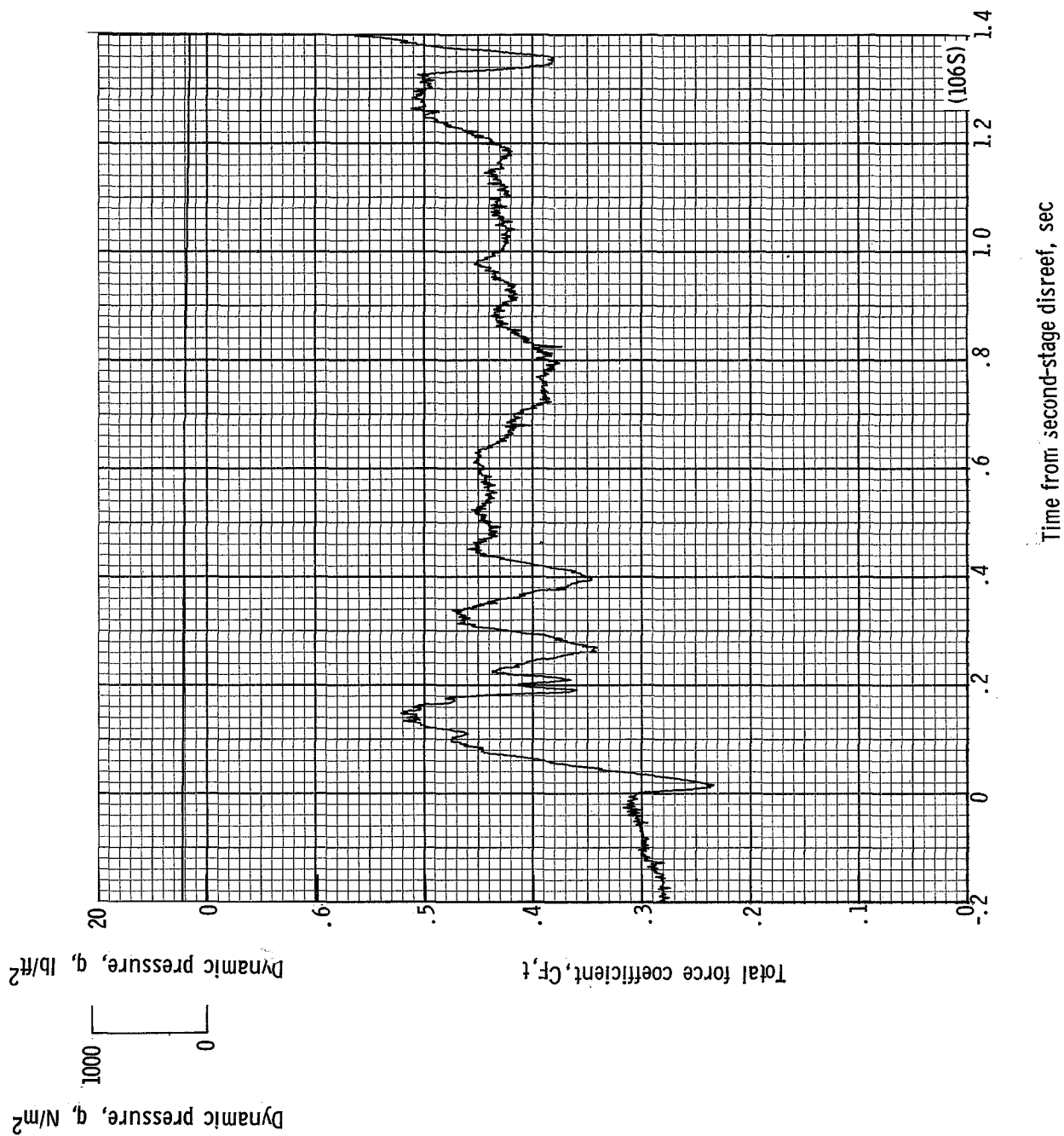
(m) Accelerations a_x , a_y , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 40.06 seconds after launch.

Figure 20.- Continued.



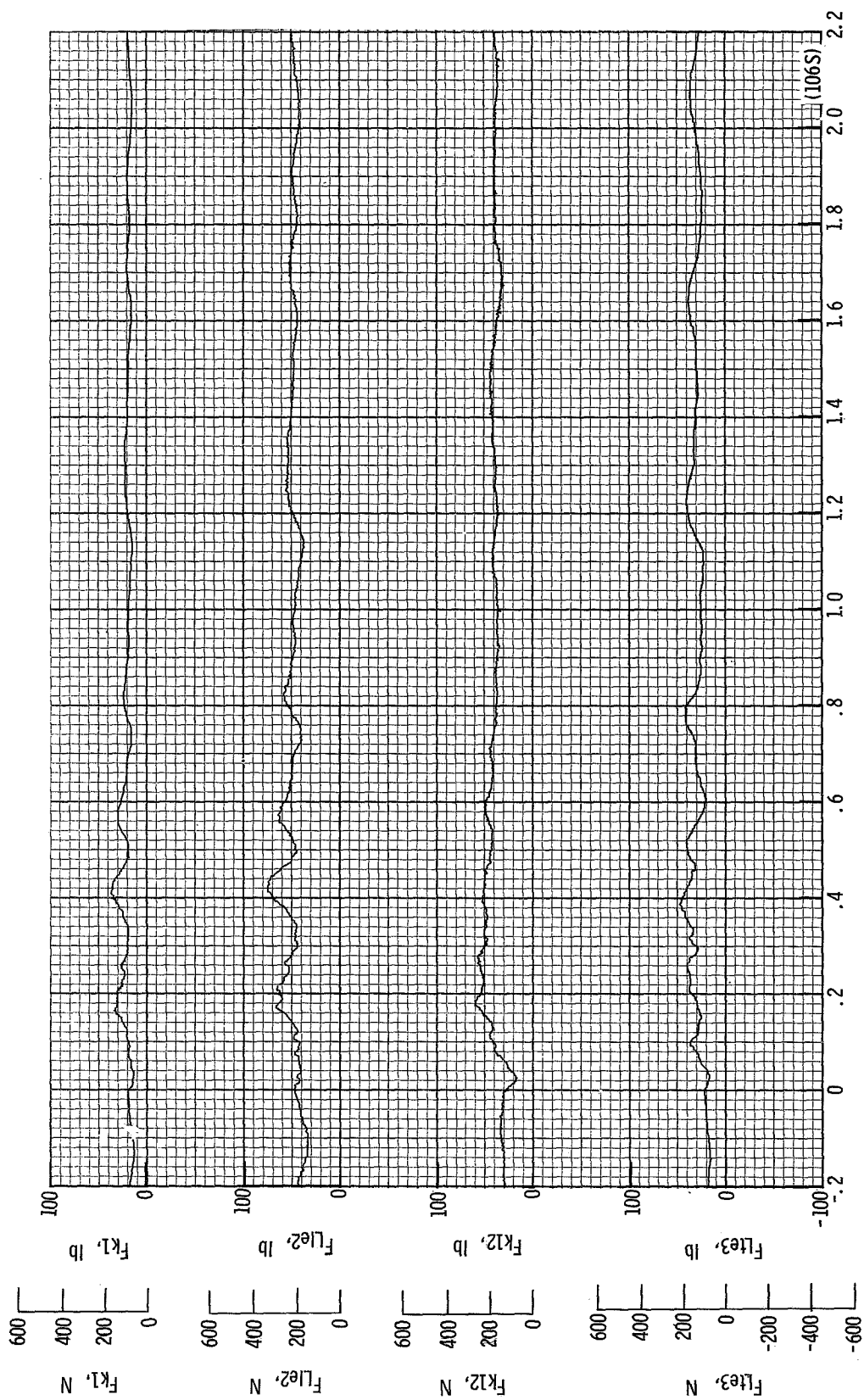
(m) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 40.06 seconds after launch.

Figure 20.- Continued.



(a) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 40.06 seconds after launch.

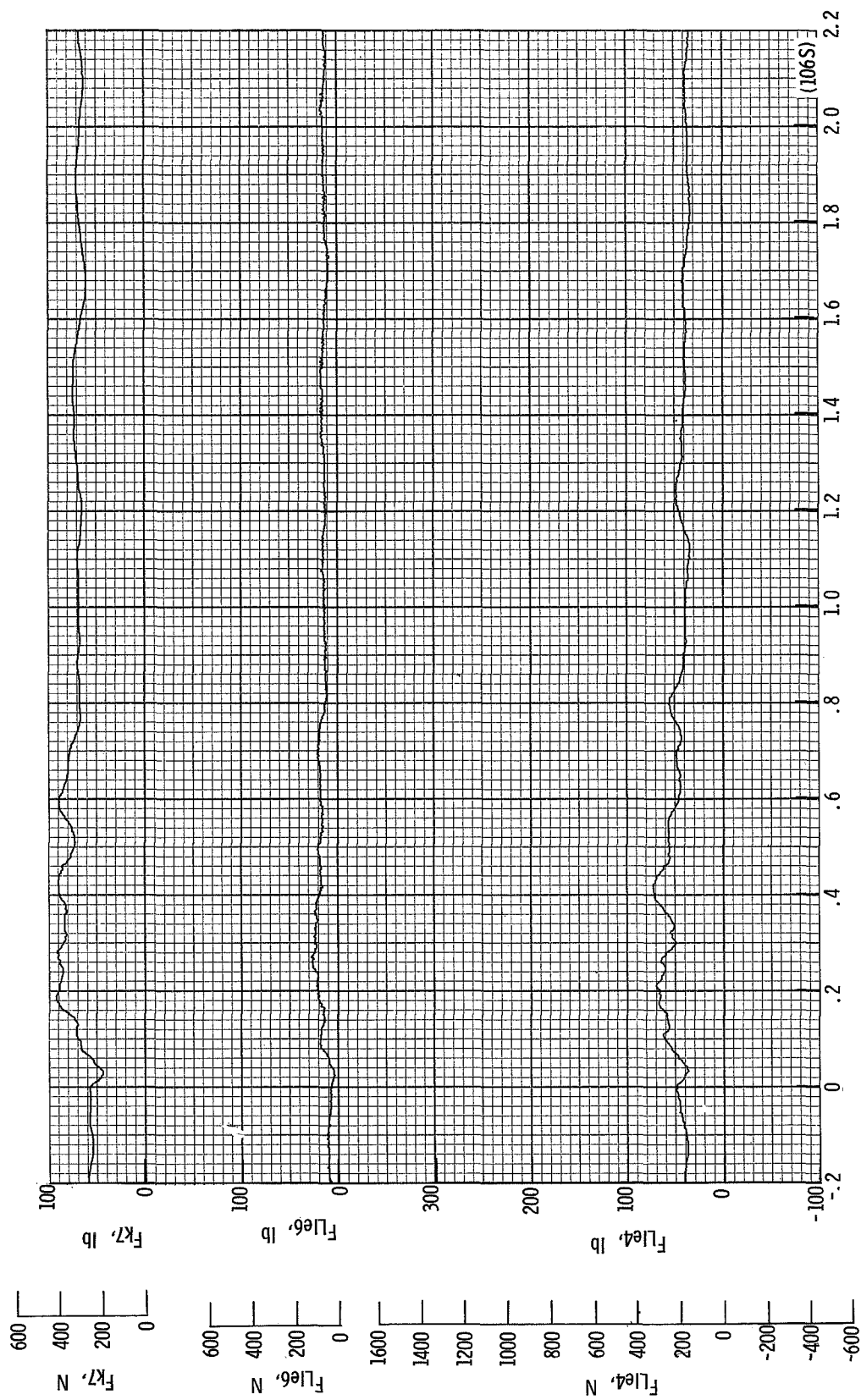
Figure 20.- Continued.



Time from third-stage disreef, sec

(p) Individual suspension-line loads F_{k1e3} , F_{k12} , F_{k1e2} , and F_{k1} plotted against time from third-stage disreef. Time = 0 second corresponds to 41.39 seconds after launch.

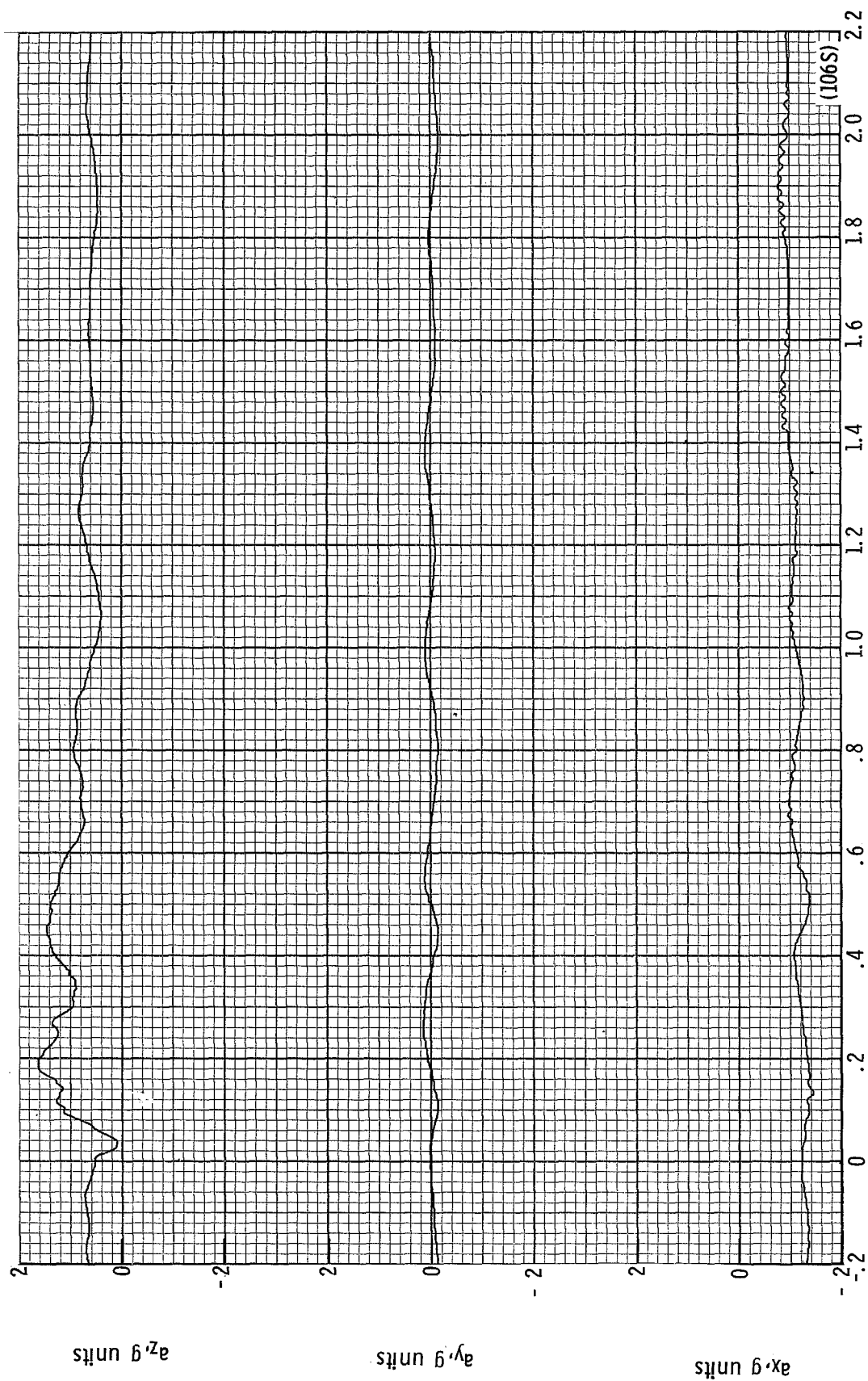
Figure 20.- Continued.



Time from third-stage disreef, sec

(q) Individual suspension-line loads F_{Lle4} , F_{Lle6} and F_{K7} plotted against time from third-stage disreef. Time = 0 second corresponds to 41.39 seconds after launch.

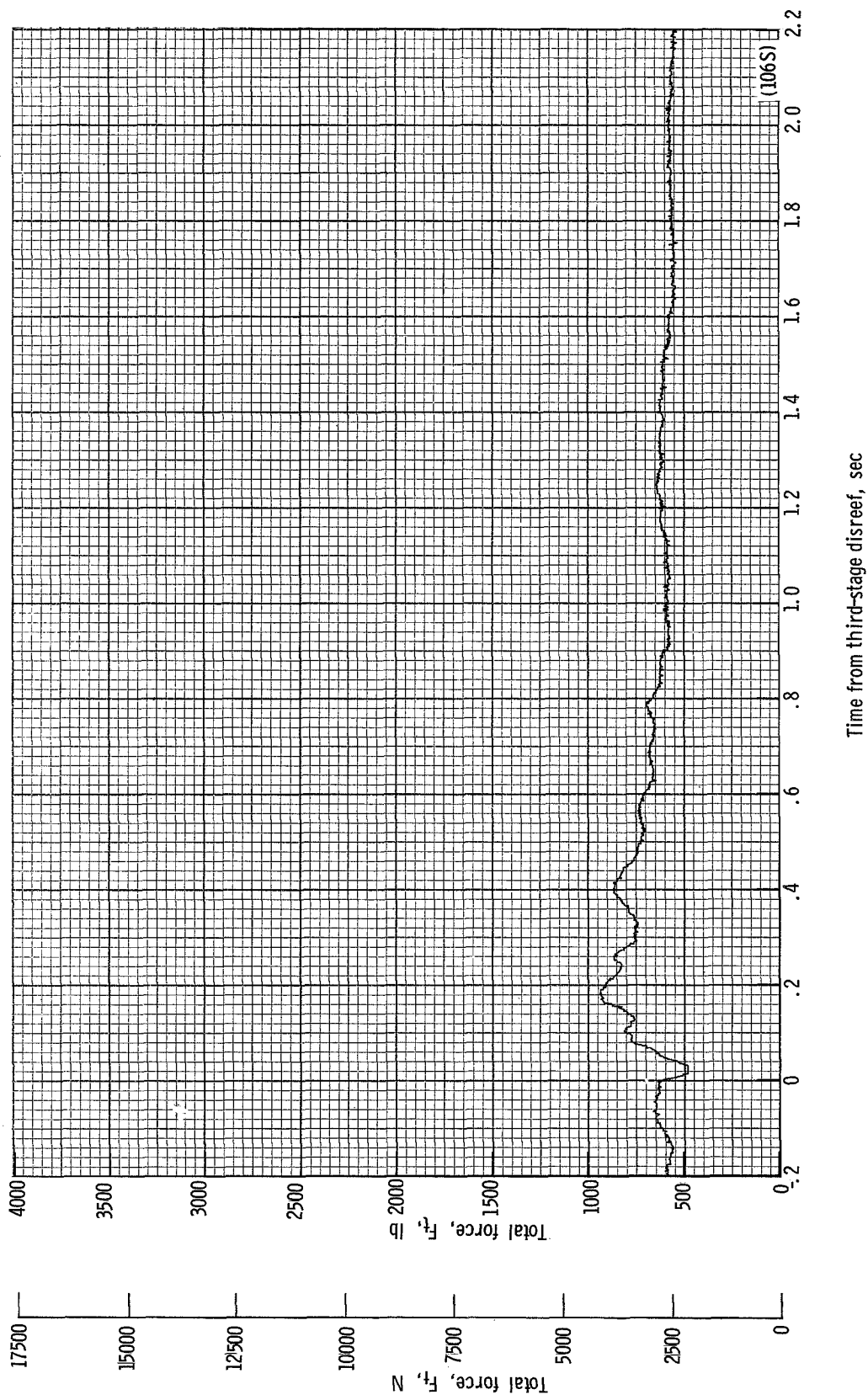
Figure 20.- Continued.



Time from third-stage disreef, sec

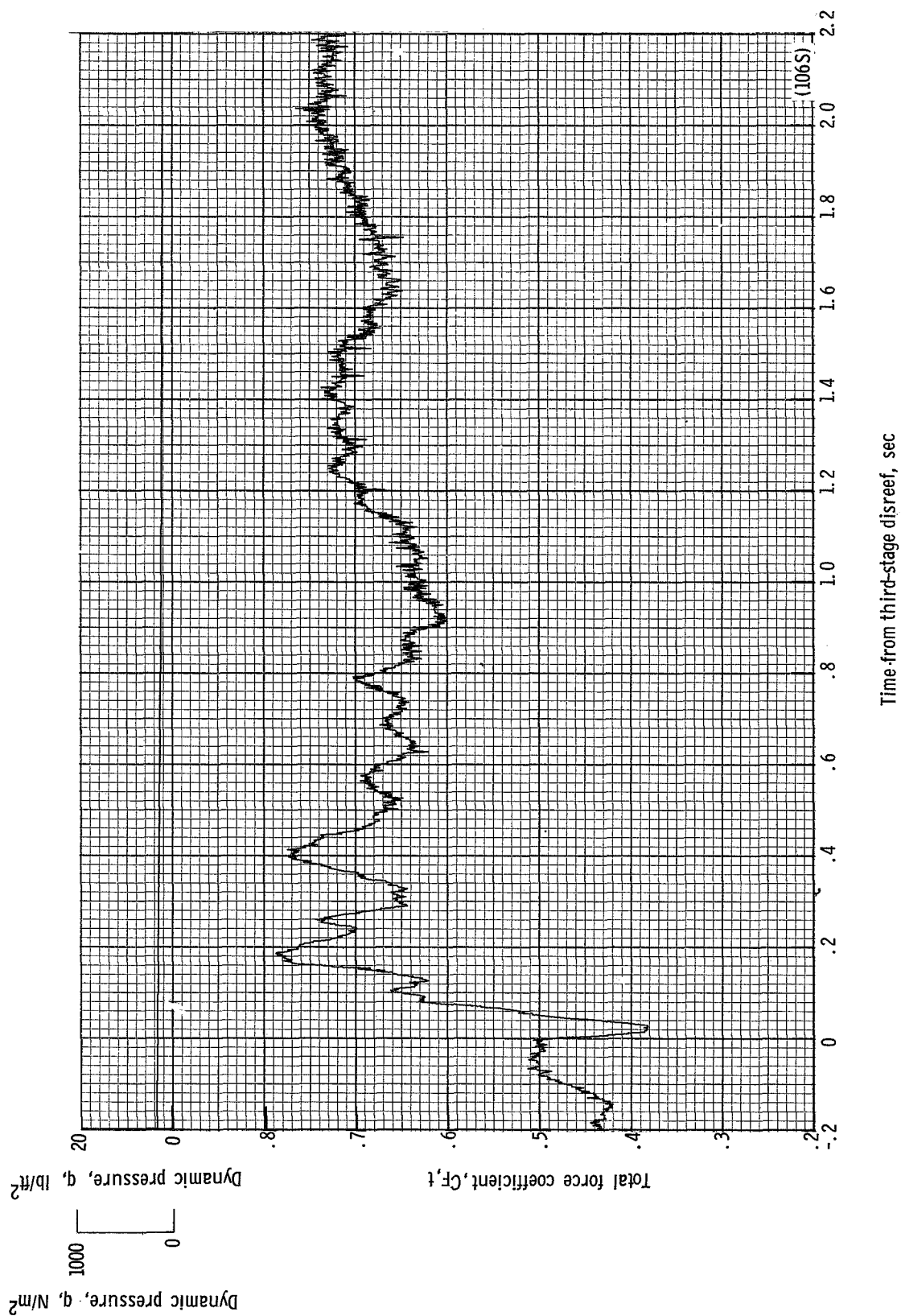
(r) Accelerations a_x , a_y , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 41.39 seconds after launch.

Figure 20.- Continued.



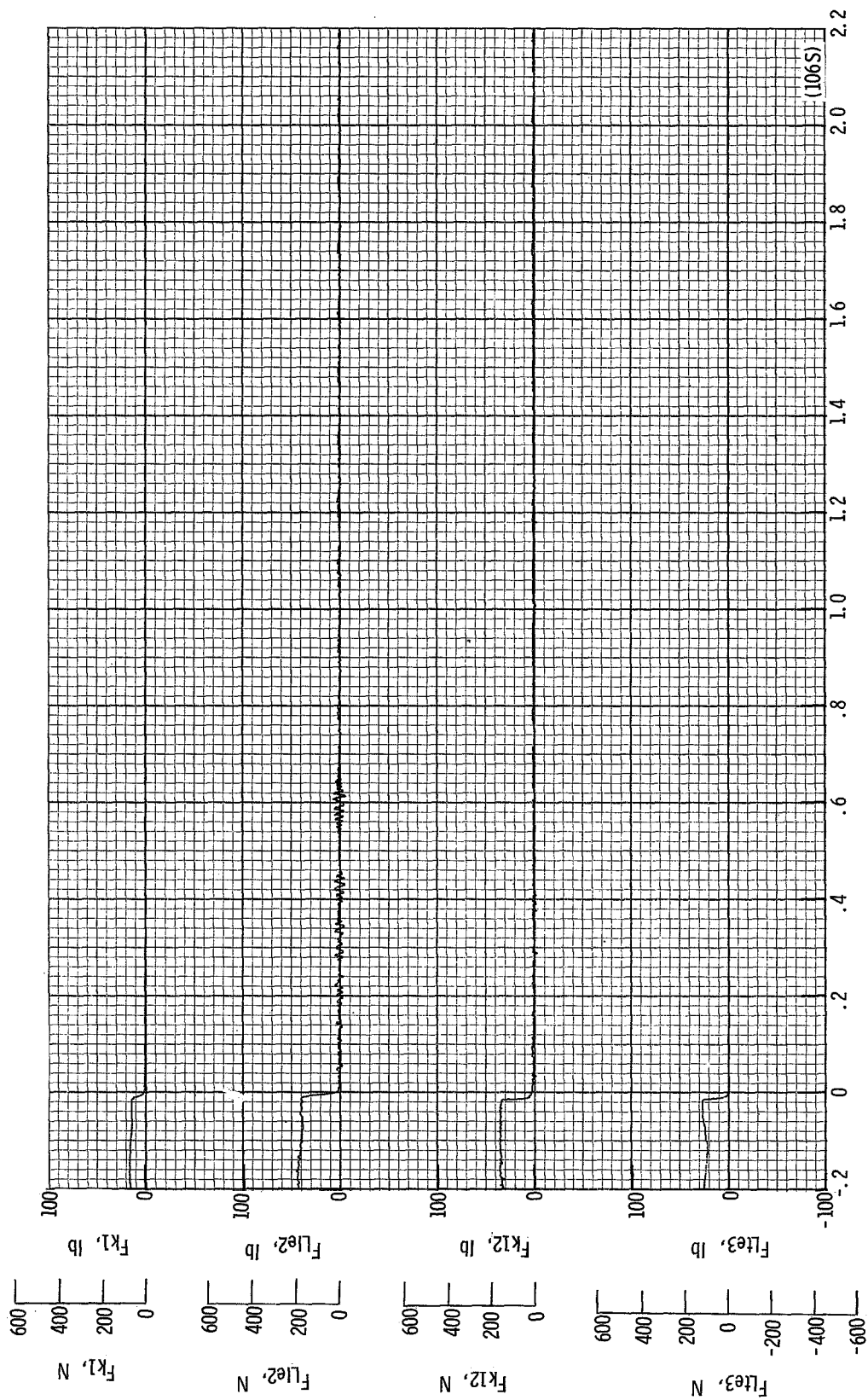
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 41.39 seconds after launch.

Figure 20.- Continued.



(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 41.39 seconds after launch.

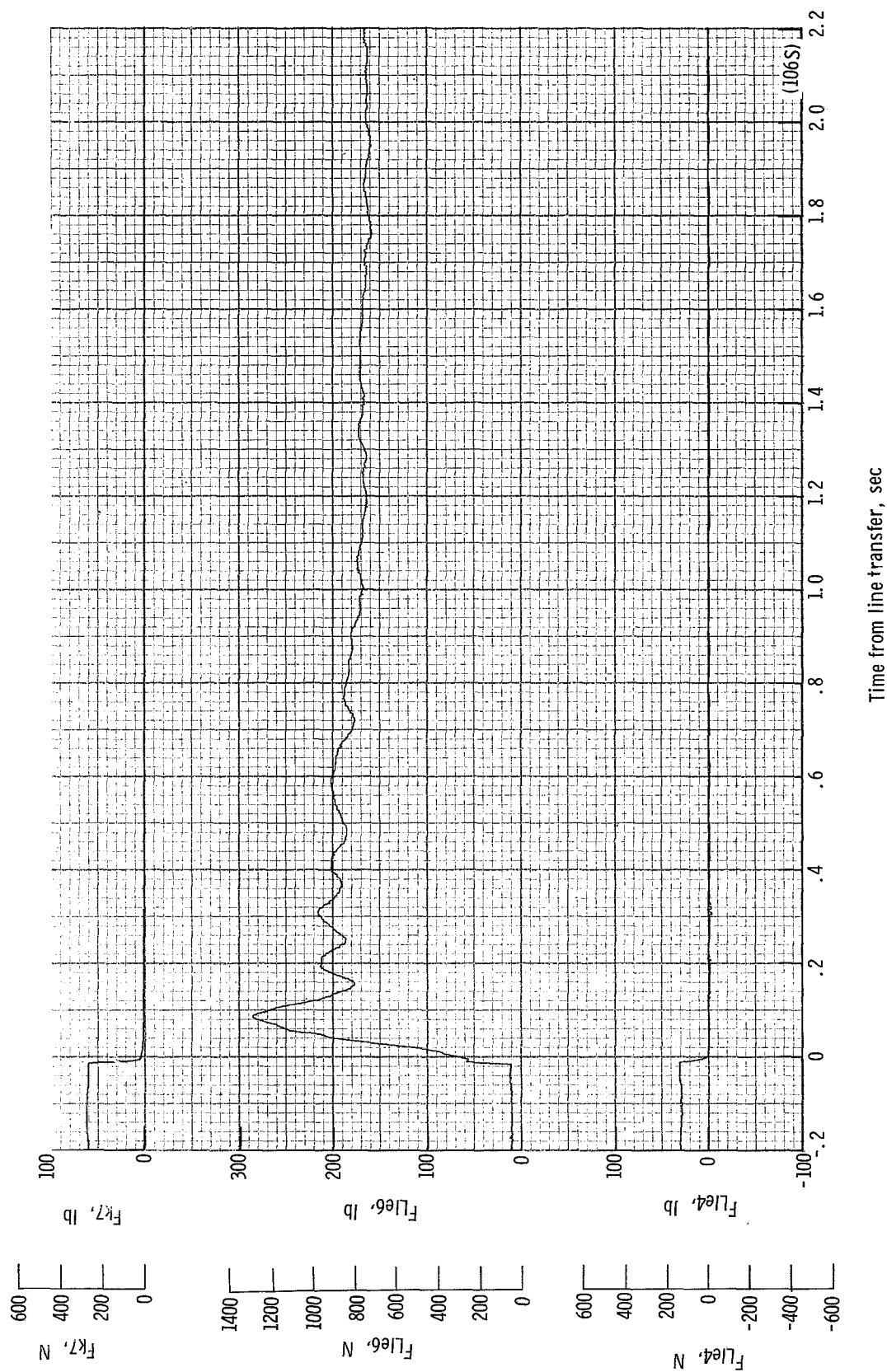
Figure 20.- Continued.



Time from line transfer, sec

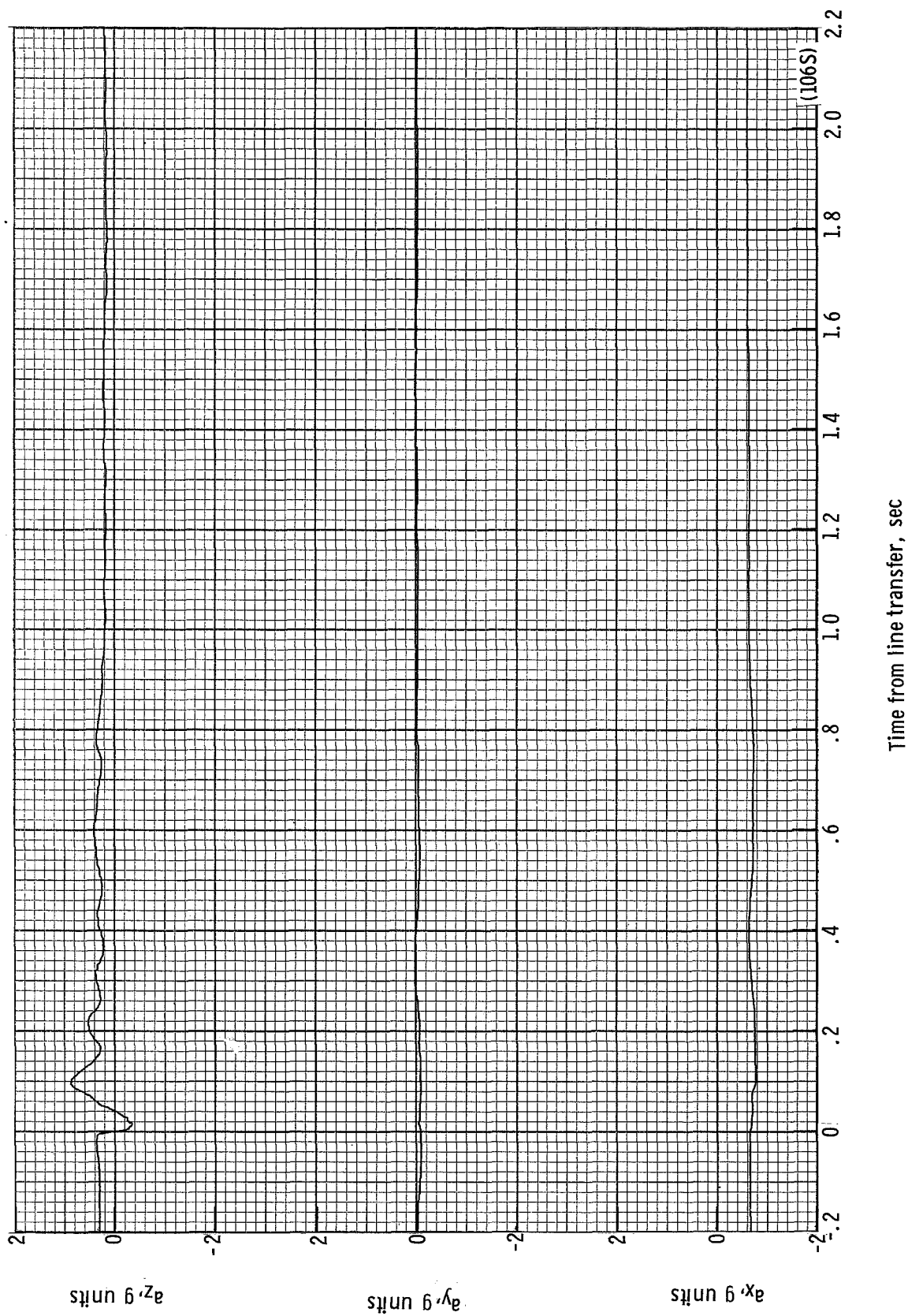
(u) Individual suspension-line loads F_{k1e3} , F_{k12} , F_{k2} , and F_{k1} plotted against time from line transfer. Time = 0 second corresponds to 44.85 seconds after launch.

Figure 20.- Continued.



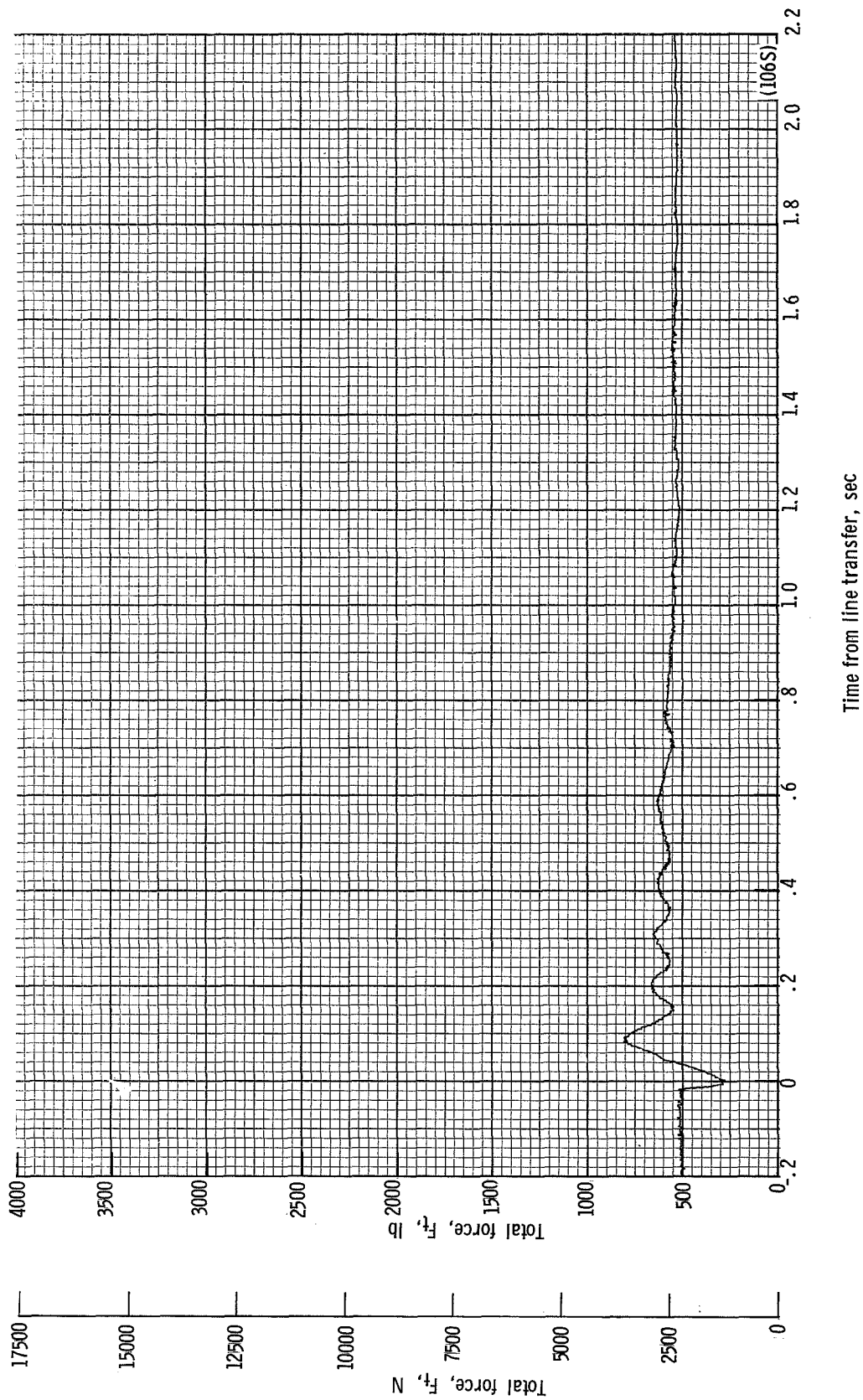
(v) Individual suspension-line loads F_{Lle4} , F_{Lle6} and F_{k7} plotted against time from line transfer. Time = 0 second corresponds to 44.85 seconds after launch.

Figure 20.- Continued.



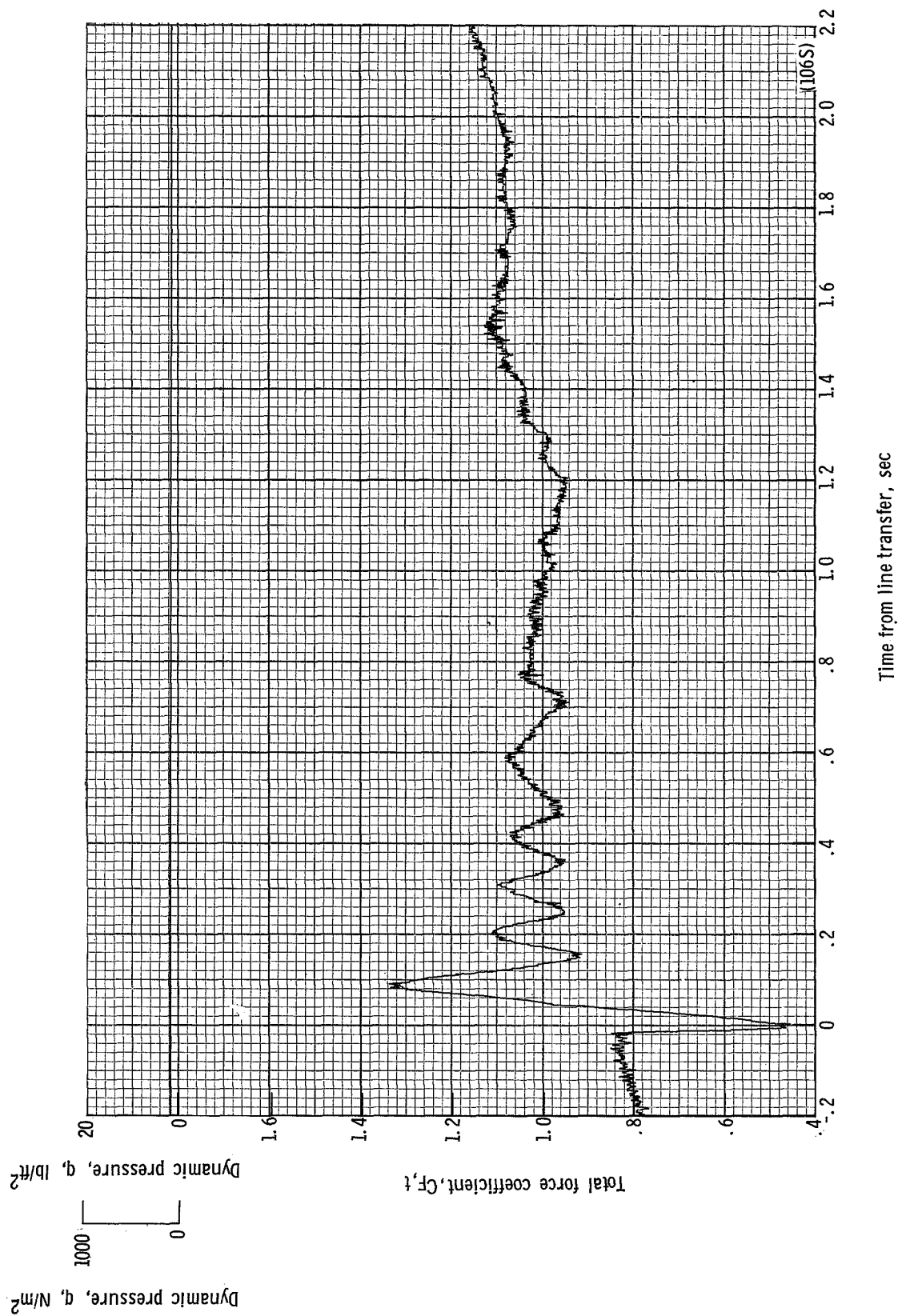
(w) Accelerations a_x , a_y , and a_z plotted against time from line transfer. Time = 0 second corresponds to 44.85 seconds after launch.

Figure 20.- Continued.



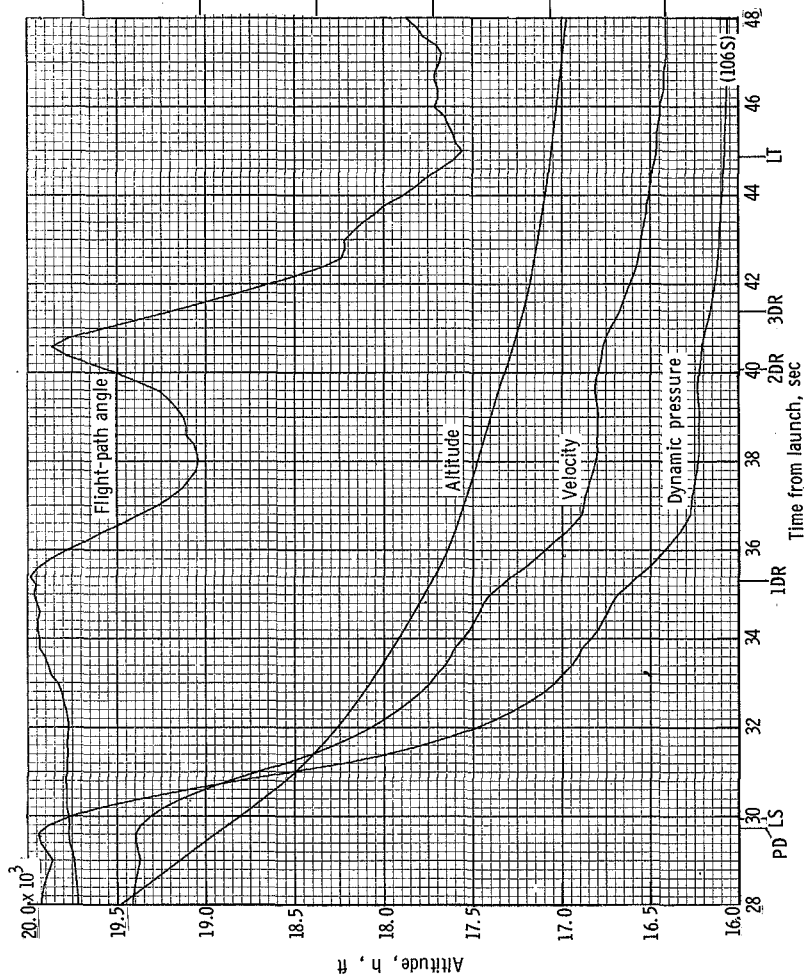
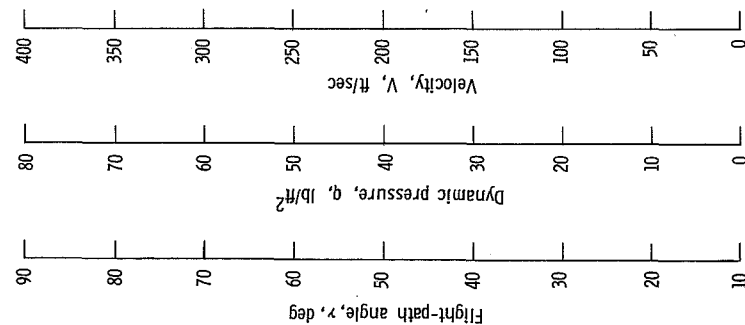
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 44.85 seconds after launch.

Figure 20.- Continued.



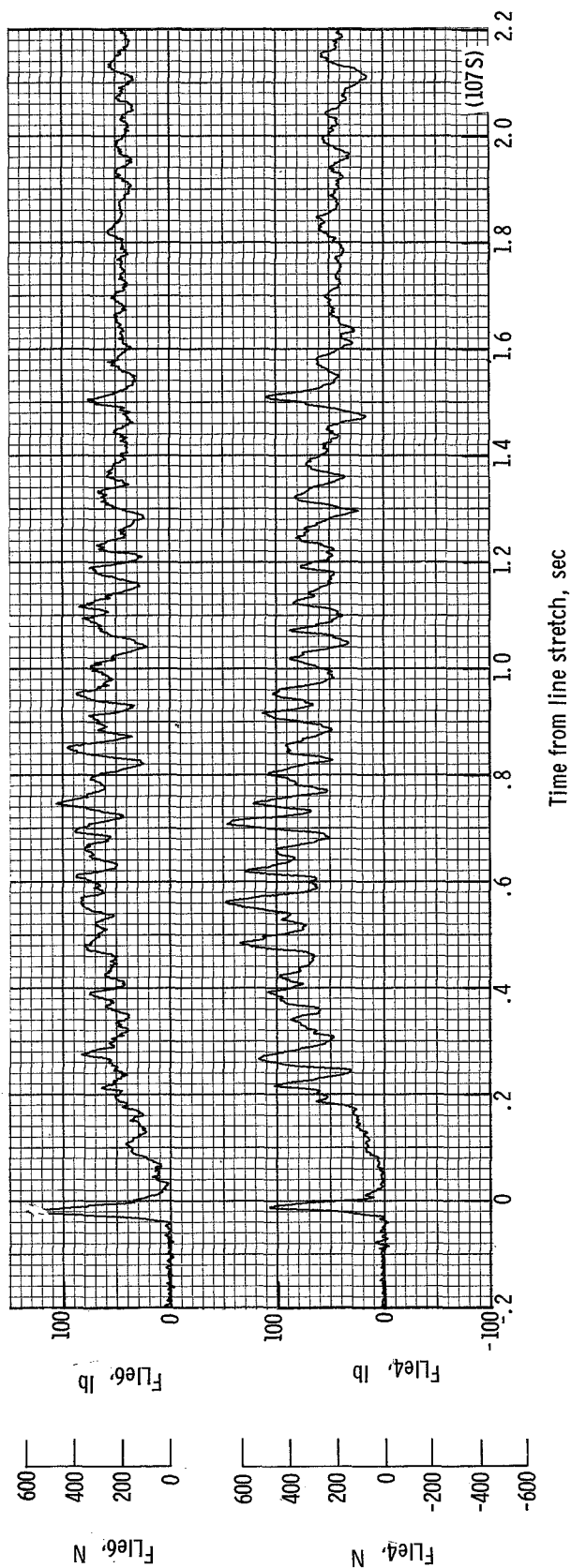
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 44.85 seconds after launch.

Figure 20.- Continued.



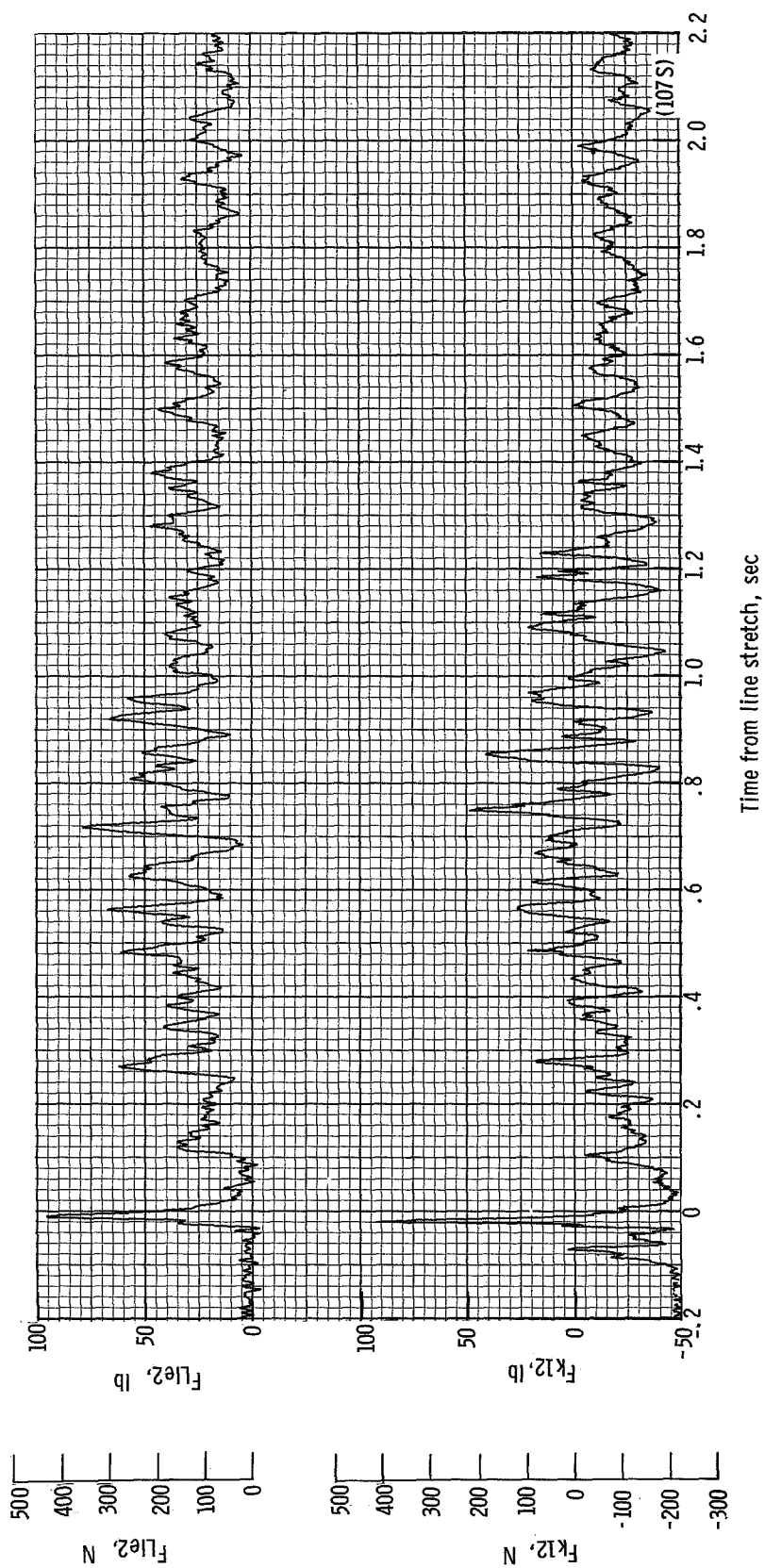
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 20.- Concluded.



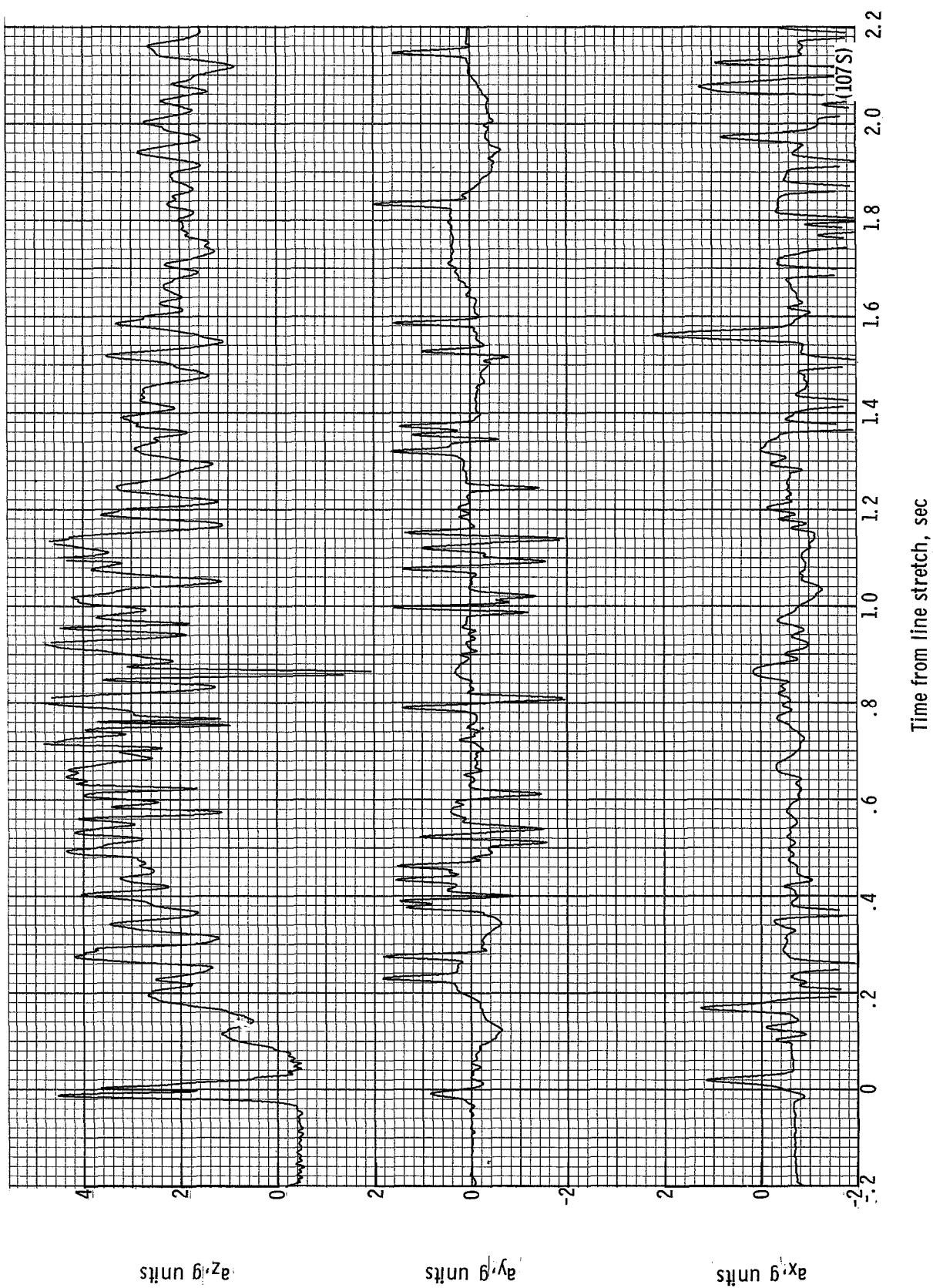
(a) Individual suspension-line loads F_{Lle4} and F_{Lle6} plotted against time from line stretch. Time = 0 second corresponds to 27.44 seconds after launch.

Figure 21.- Time history of single-keel parawing deployment data for test 107S. $W_D = 2197$ N (493.9 lb); $W_P = 2059.1$ N (462.9 lb); $q_{PD} = 4122.9$ N/m² (86.1 lb/ft²); $h_{PD} = 5965$ m (19 570 ft); $l_r/l_k = 0.116$; reefing version II.



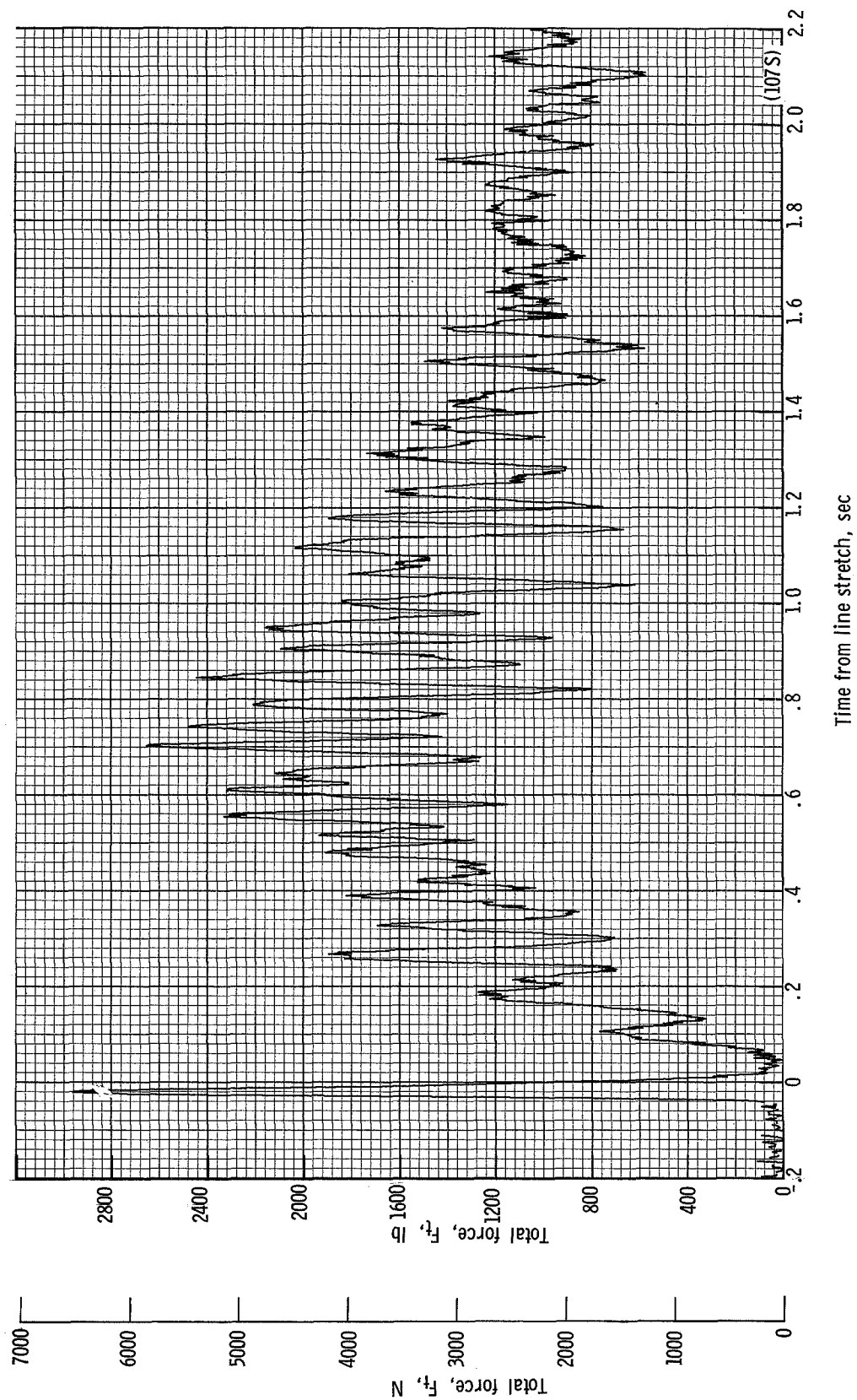
(b) Individual suspension-line loads F_{k12} and F_{lie2} plotted against time from line stretch. Time = 0 second corresponds to 27.44 seconds after launch.

Figure 21.- Continued.



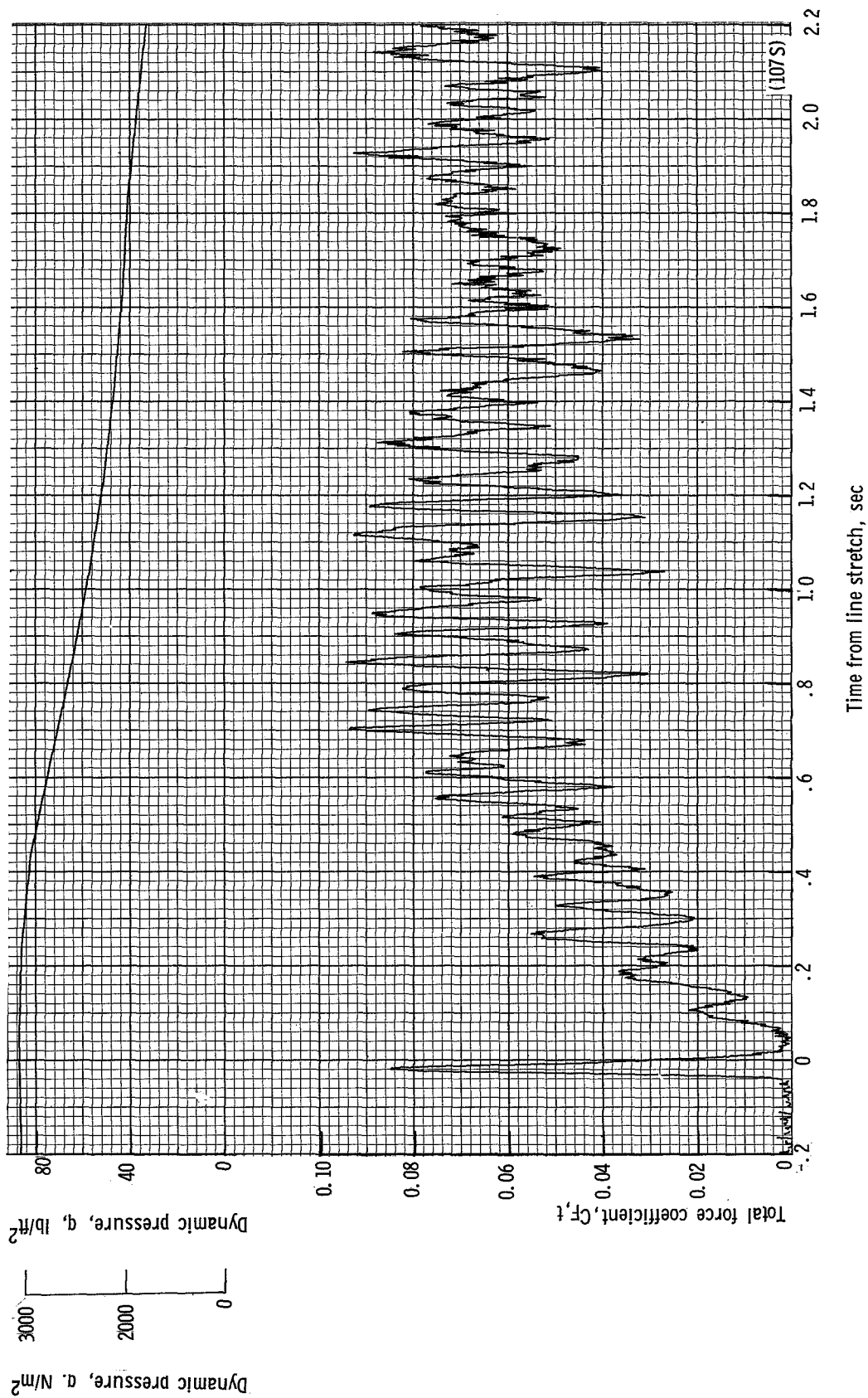
(c) Accelerations a_x , a_y , and a_z plotted against time from line stretch. Time = 0 second corresponds to 27.44 seconds after launch.

Figure 21.- Continued.



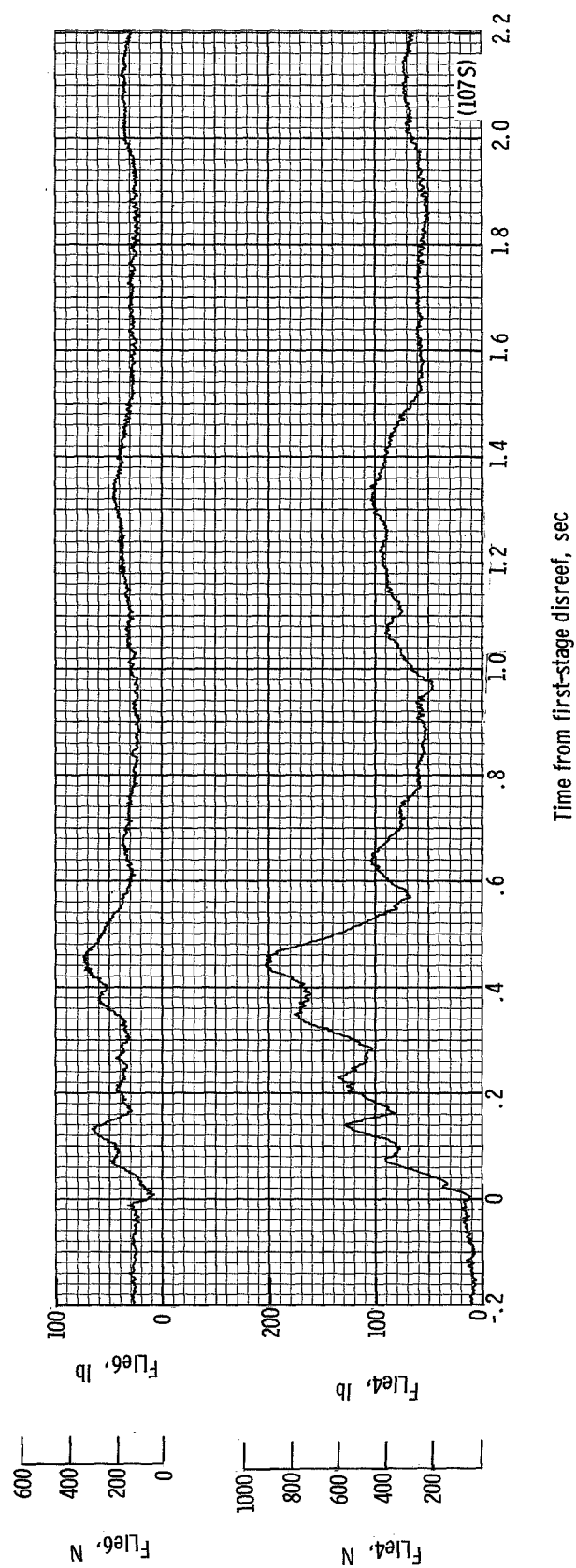
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 27.44 seconds after launch.

Figure 21.- Continued.



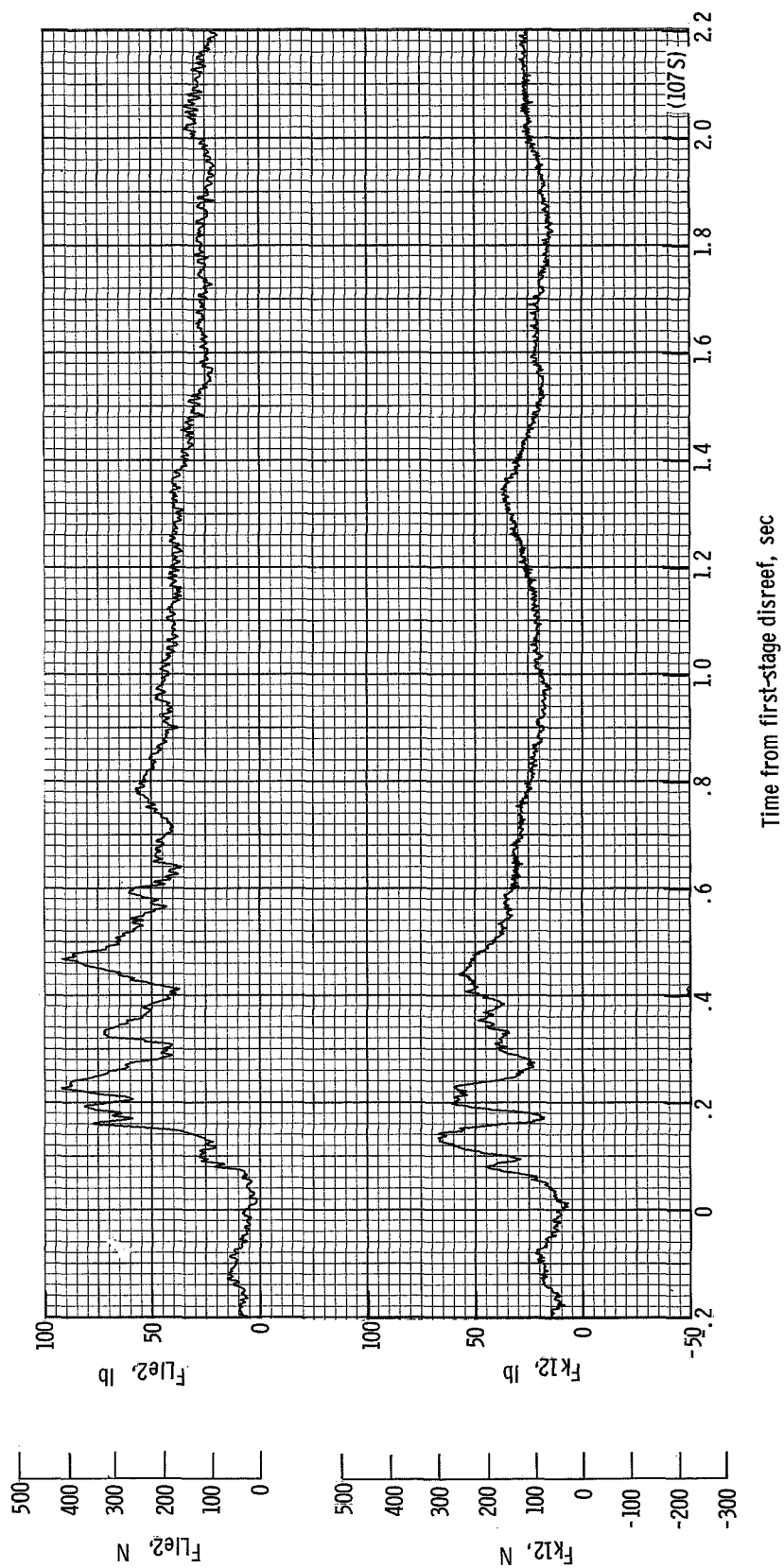
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 27.44 seconds after launch.

Figure 21.- Continued.



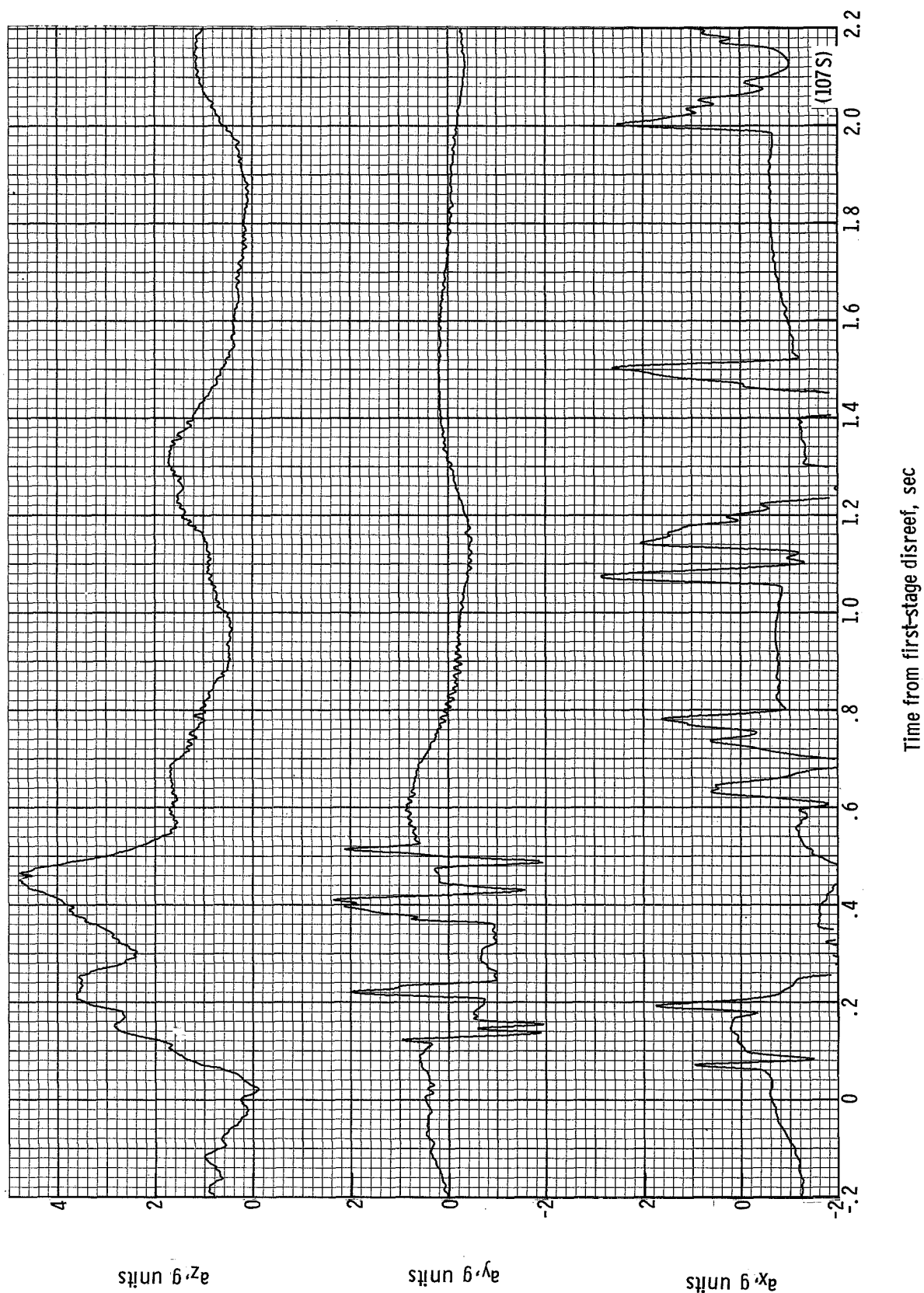
(f) Individual suspension-line loads F_{Lle4} and F_{Lle6} plotted against time from first-stage disreef. Time = 0 second corresponds to 32.71 seconds after launch.

Figure 21.- Continued.



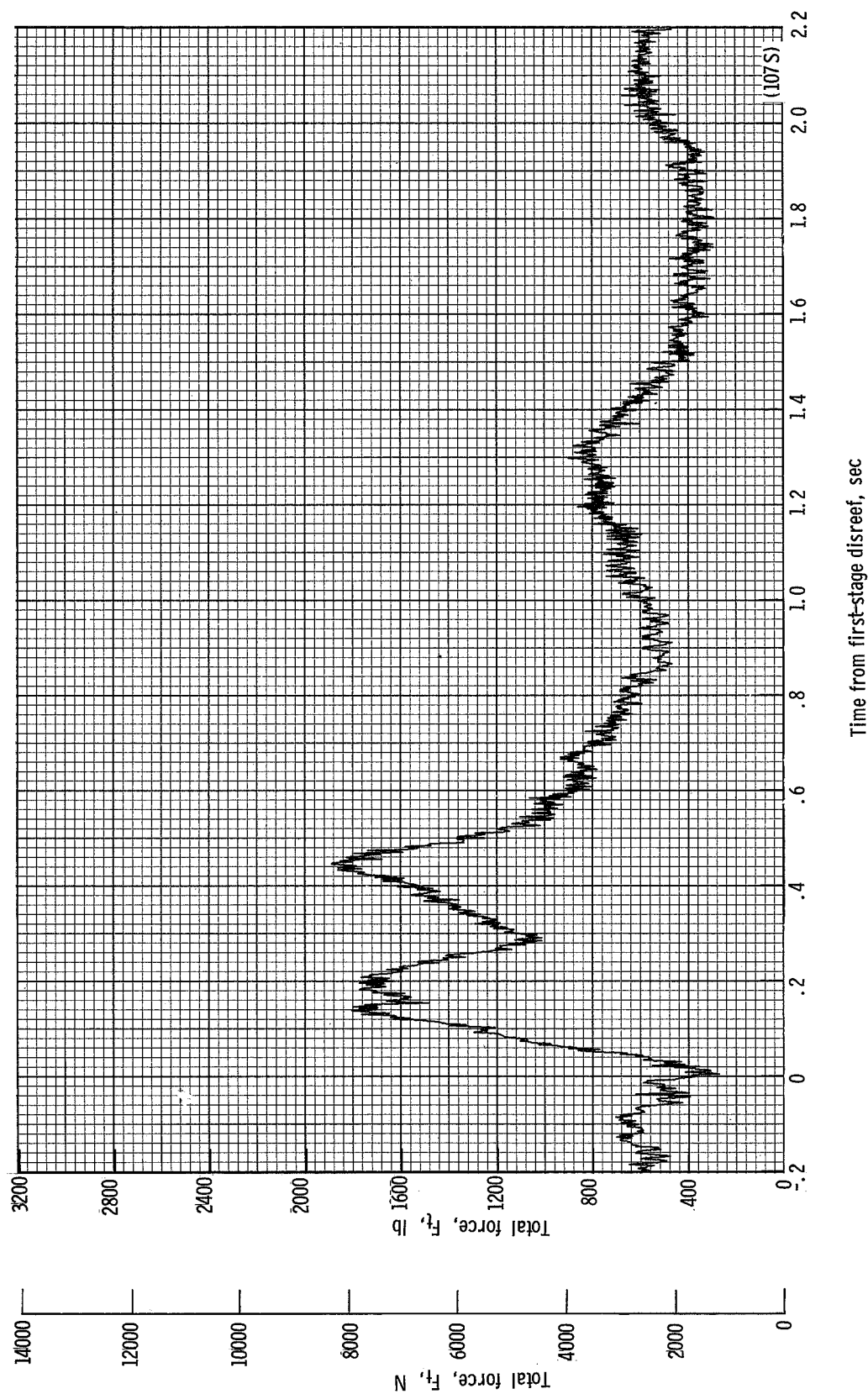
(g) Individual suspension-line loads F_{K12} and F_{L1e2} plotted against time from first-stage disreef. Time = 0 second corresponds to 32.71 seconds after launch.

Figure 21.- Continued.



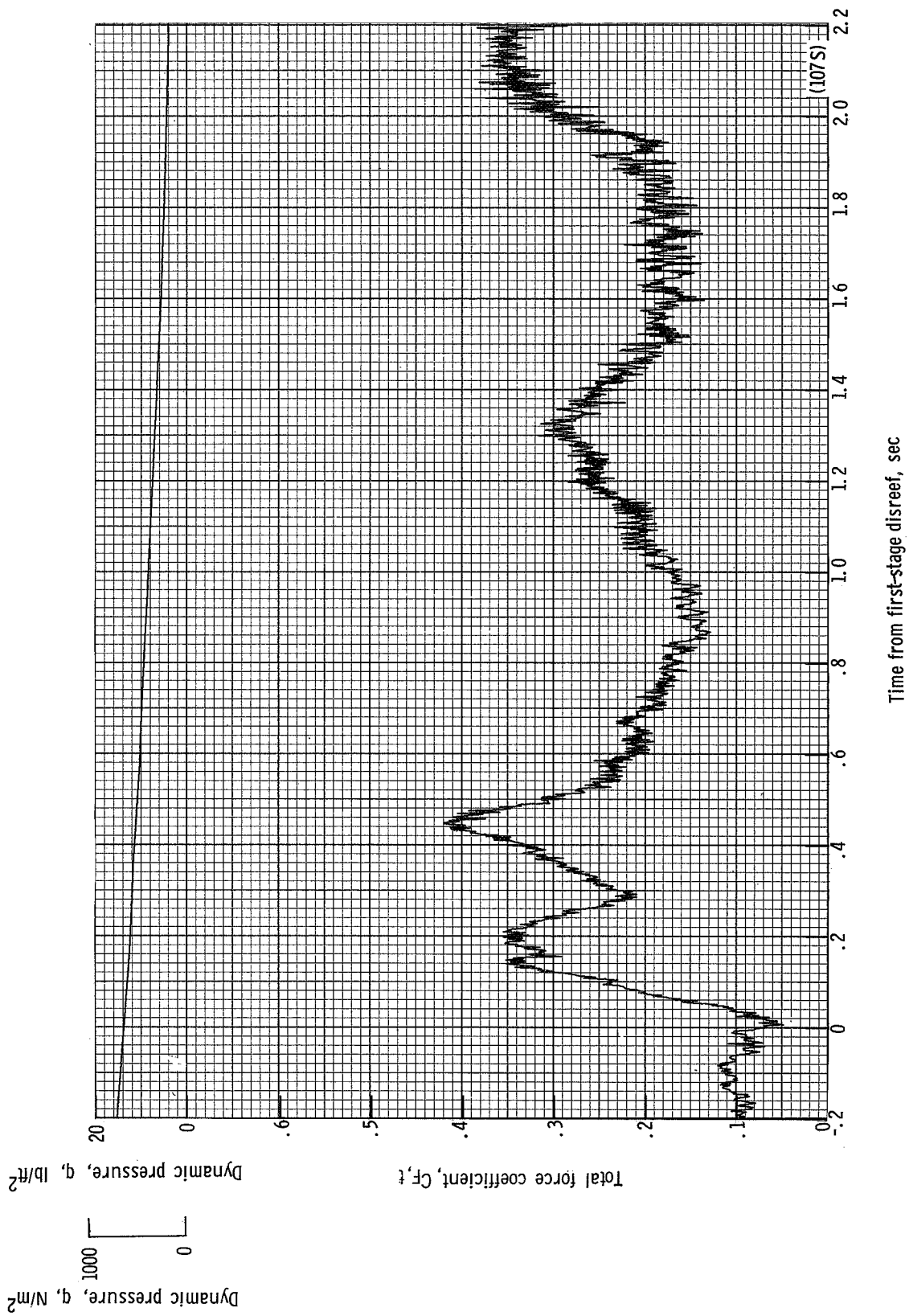
(h) Accelerations a_x , a_y , and a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 32.71 seconds after launch.

Figure 21.- Continued.



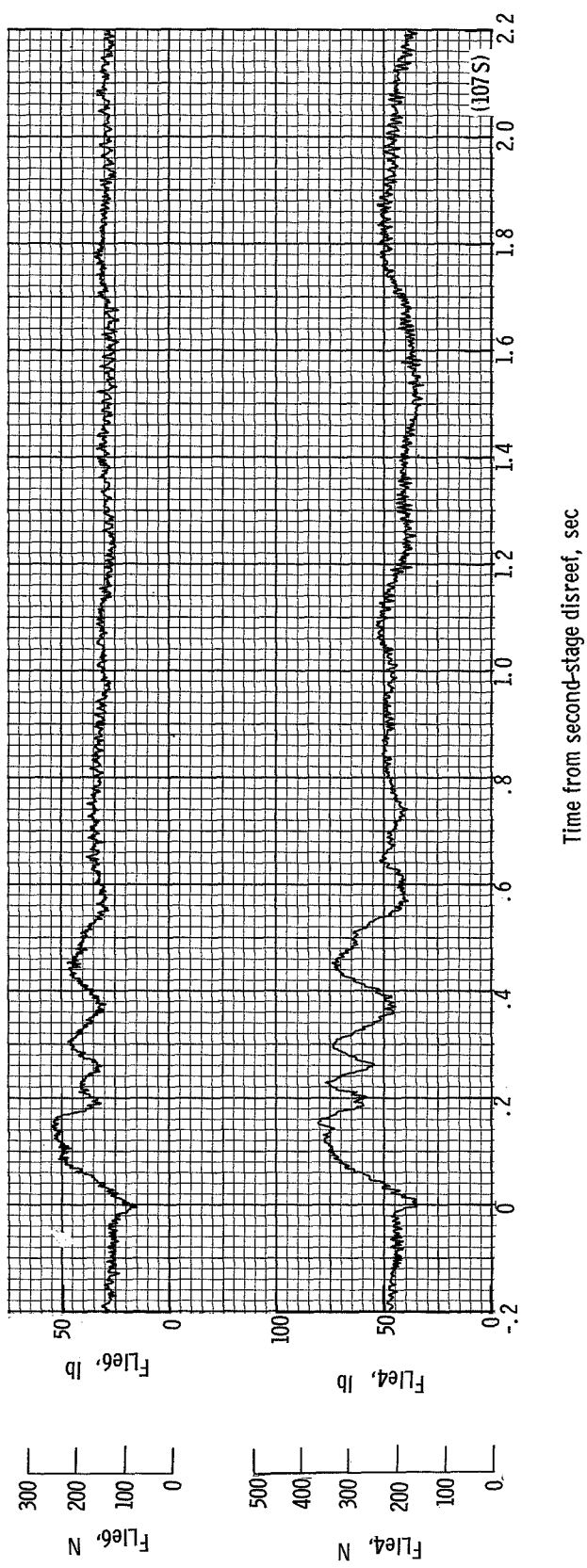
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 32.71 seconds after launch.

Figure 21.- Continued.



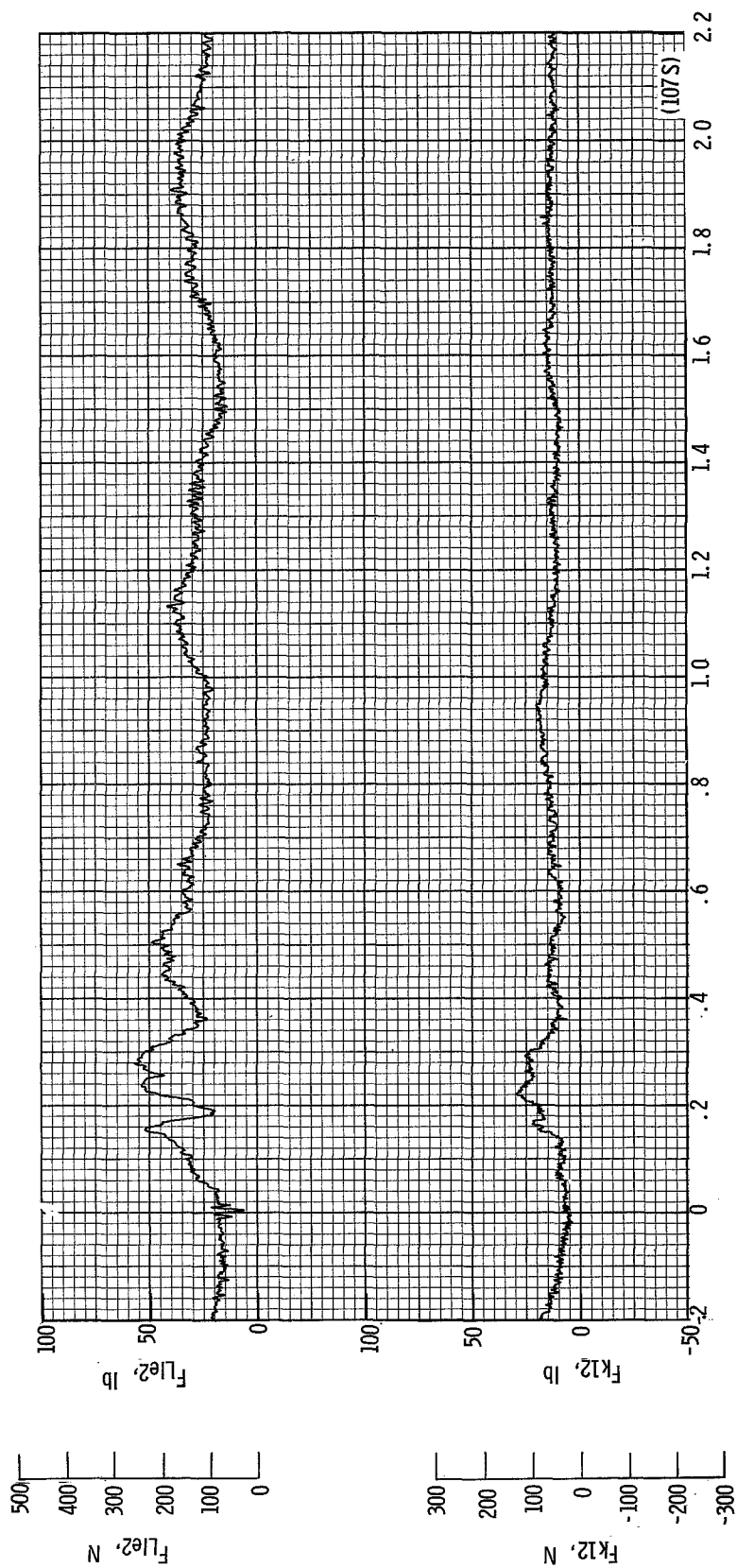
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 32.71 seconds after launch.

Figure 21.- Continued.



(k) Individual suspension-line loads F_{Lie4} and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 36.18 seconds after launch.

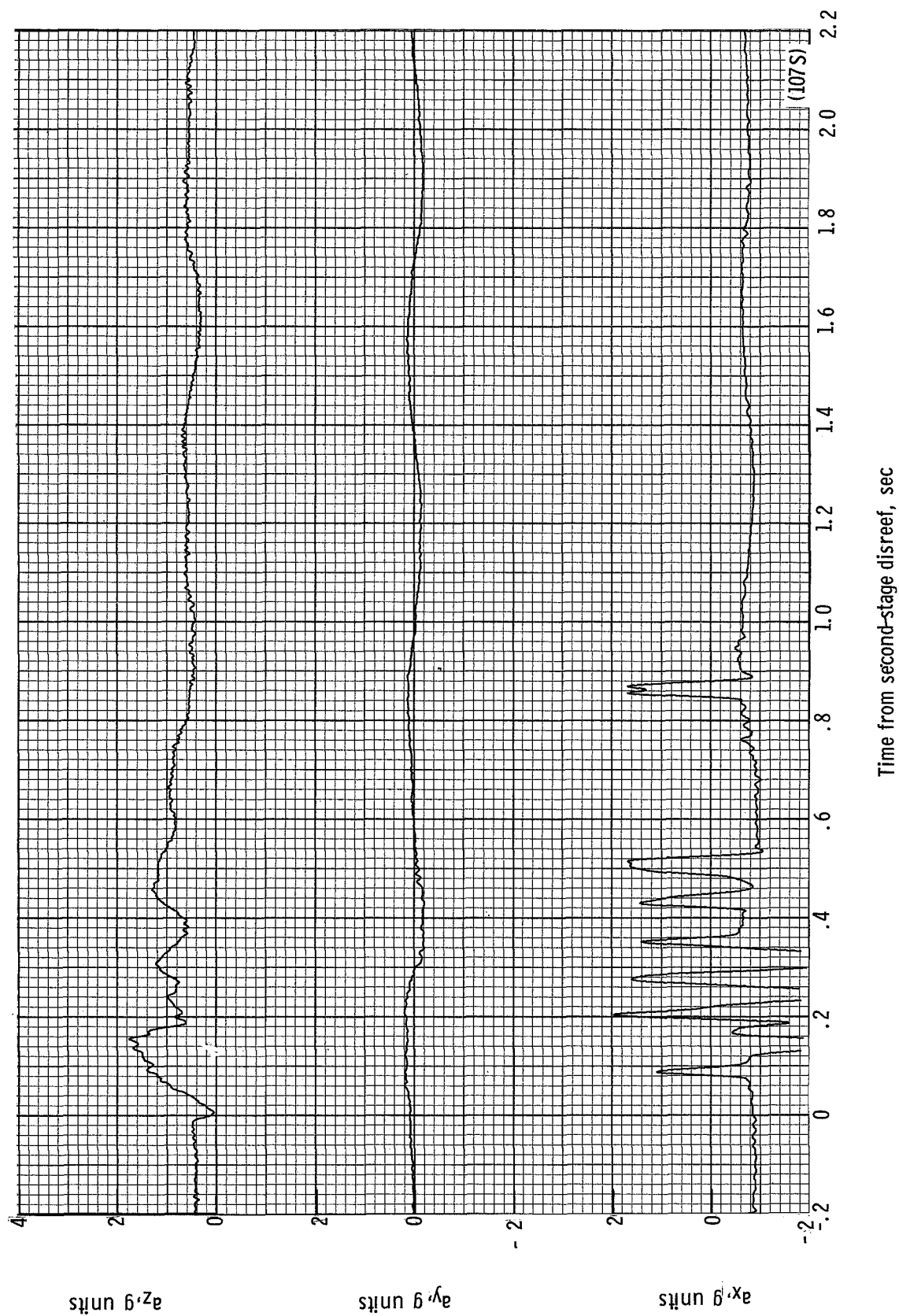
Figure 21.- Continued.



Time from second-stage disreef, sec

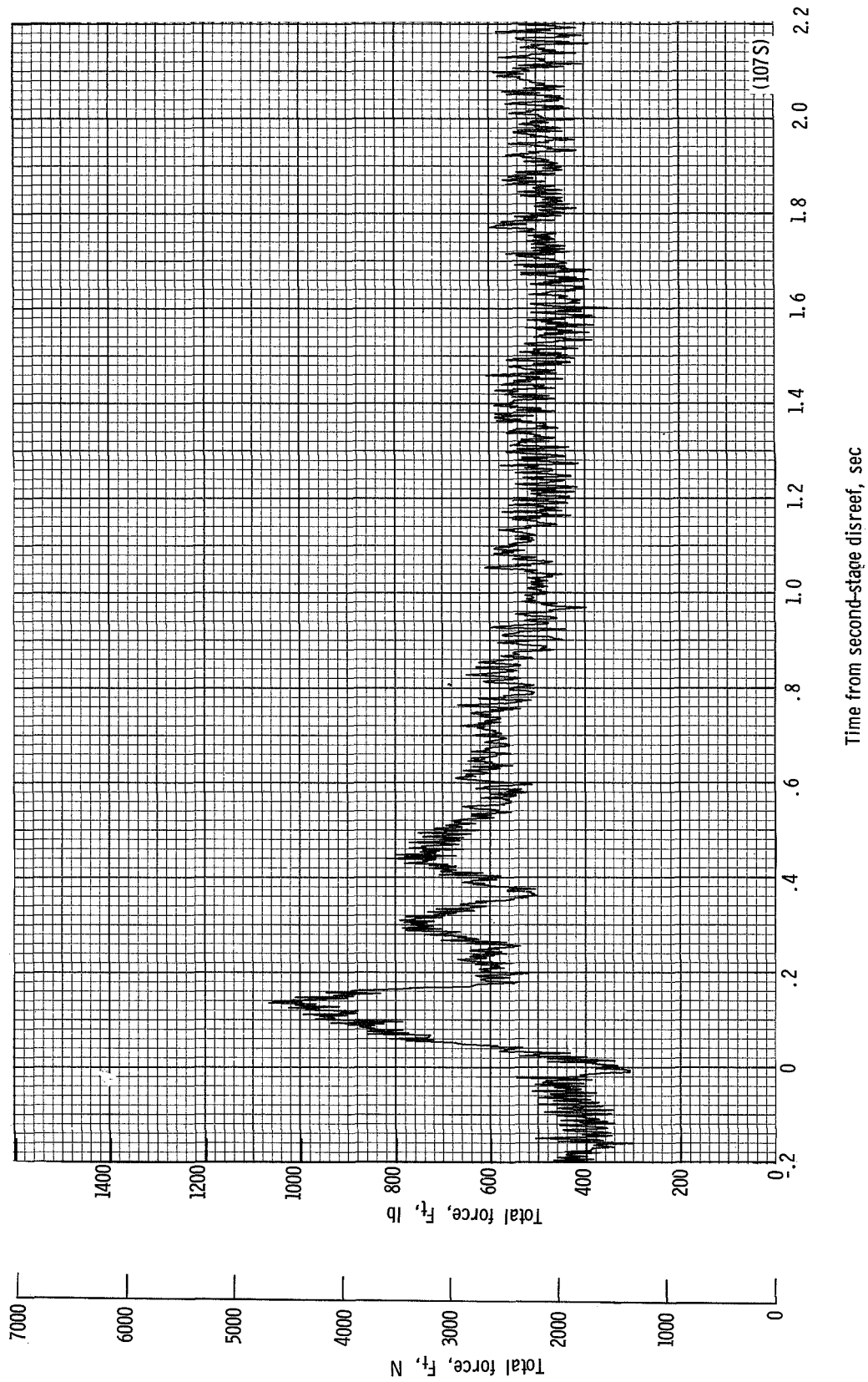
(1) Individual suspension-line loads F_{K12} and F_{L1e2} plotted against time from second-stage disreef. Time = 0 second corresponds to 36.18 seconds after launch.

Figure 21.- Continued.



(m) Accelerations a_x , a_y , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 36.18 seconds after launch.

Figure 21.- Continued.



(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 36.18 seconds after launch.

Figure 21.- Continued.

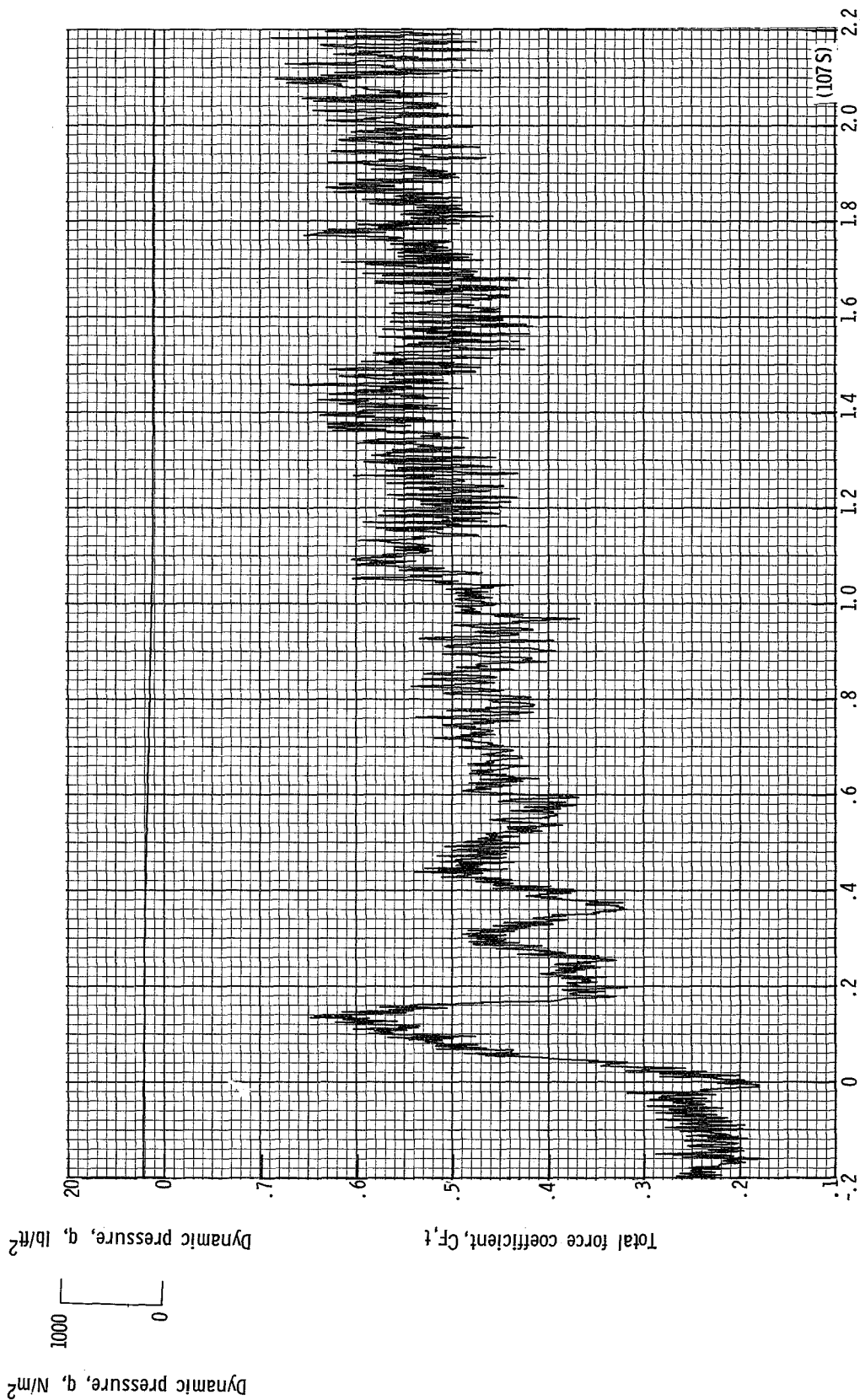
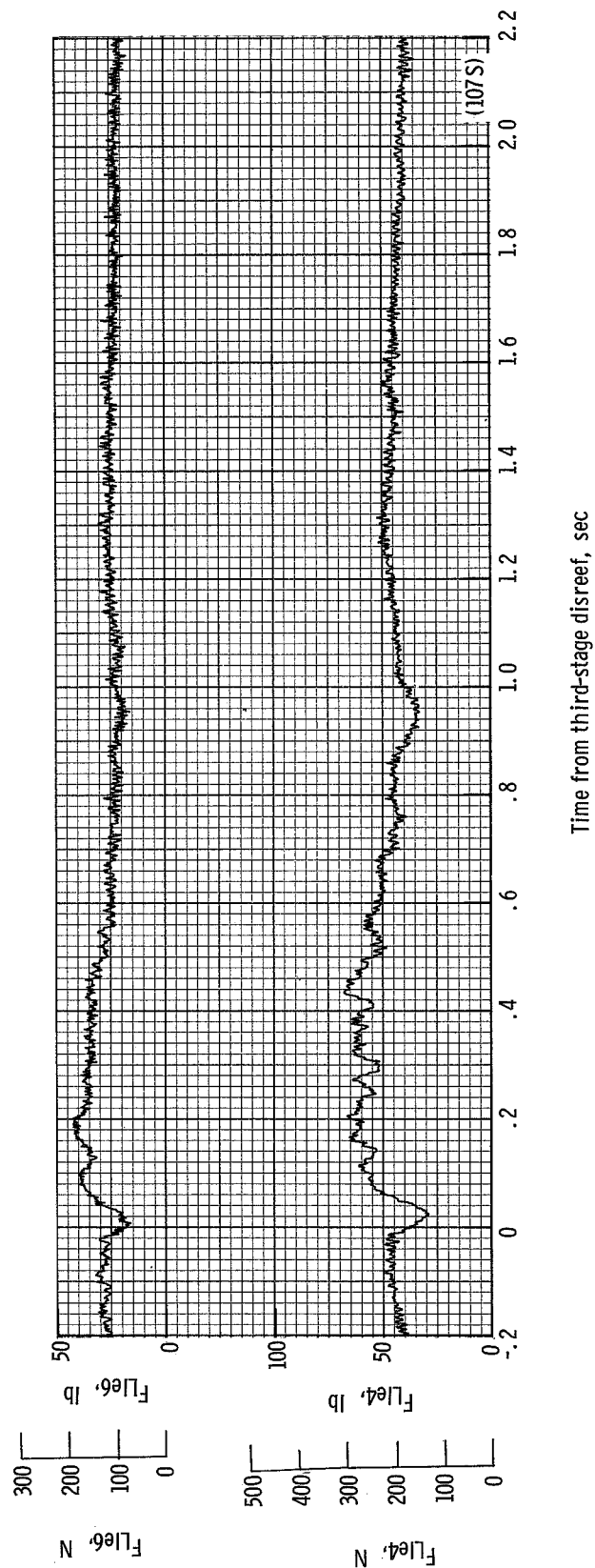


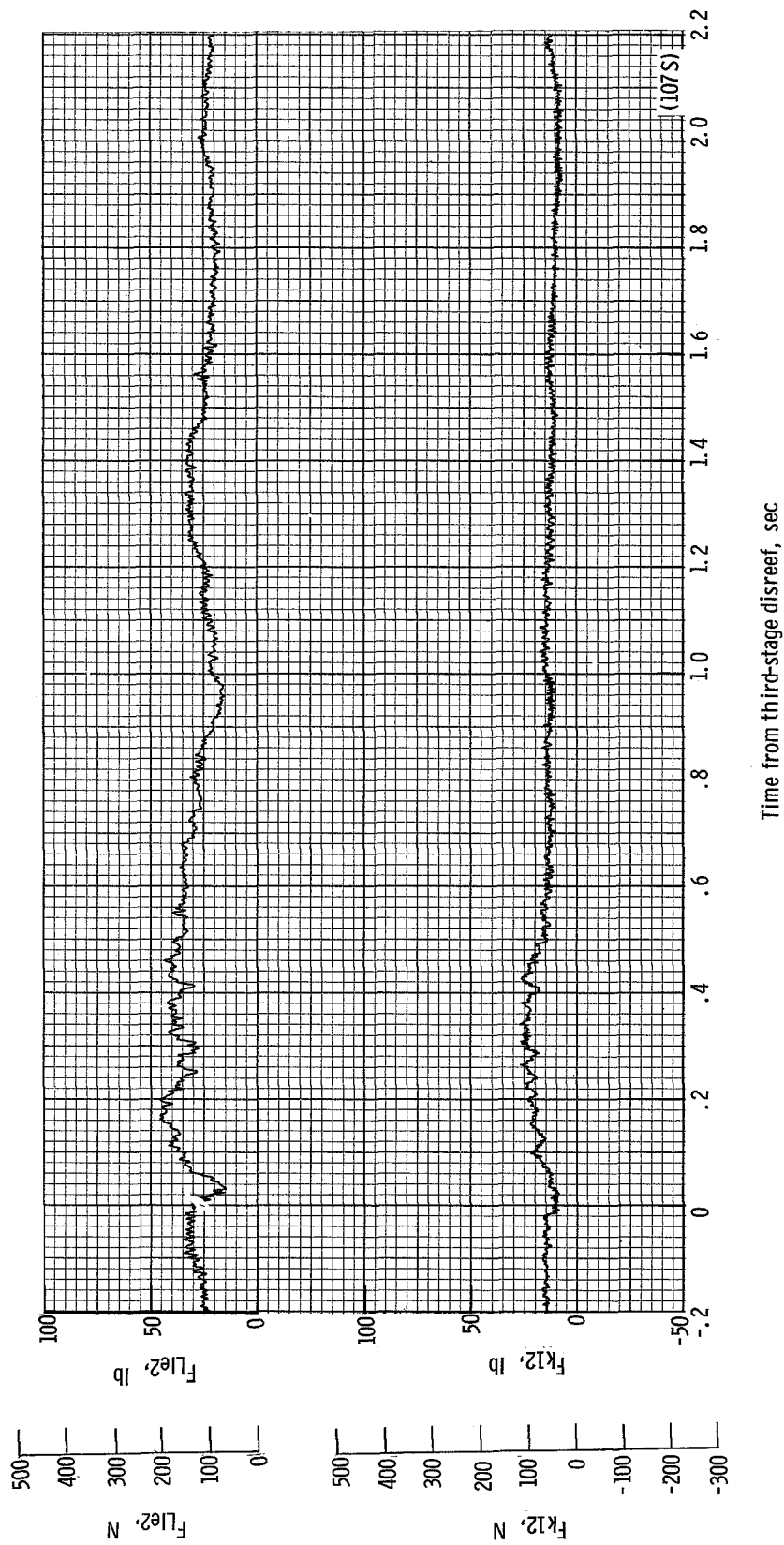
Figure 21.- Continued.

(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 36.18 seconds after launch.



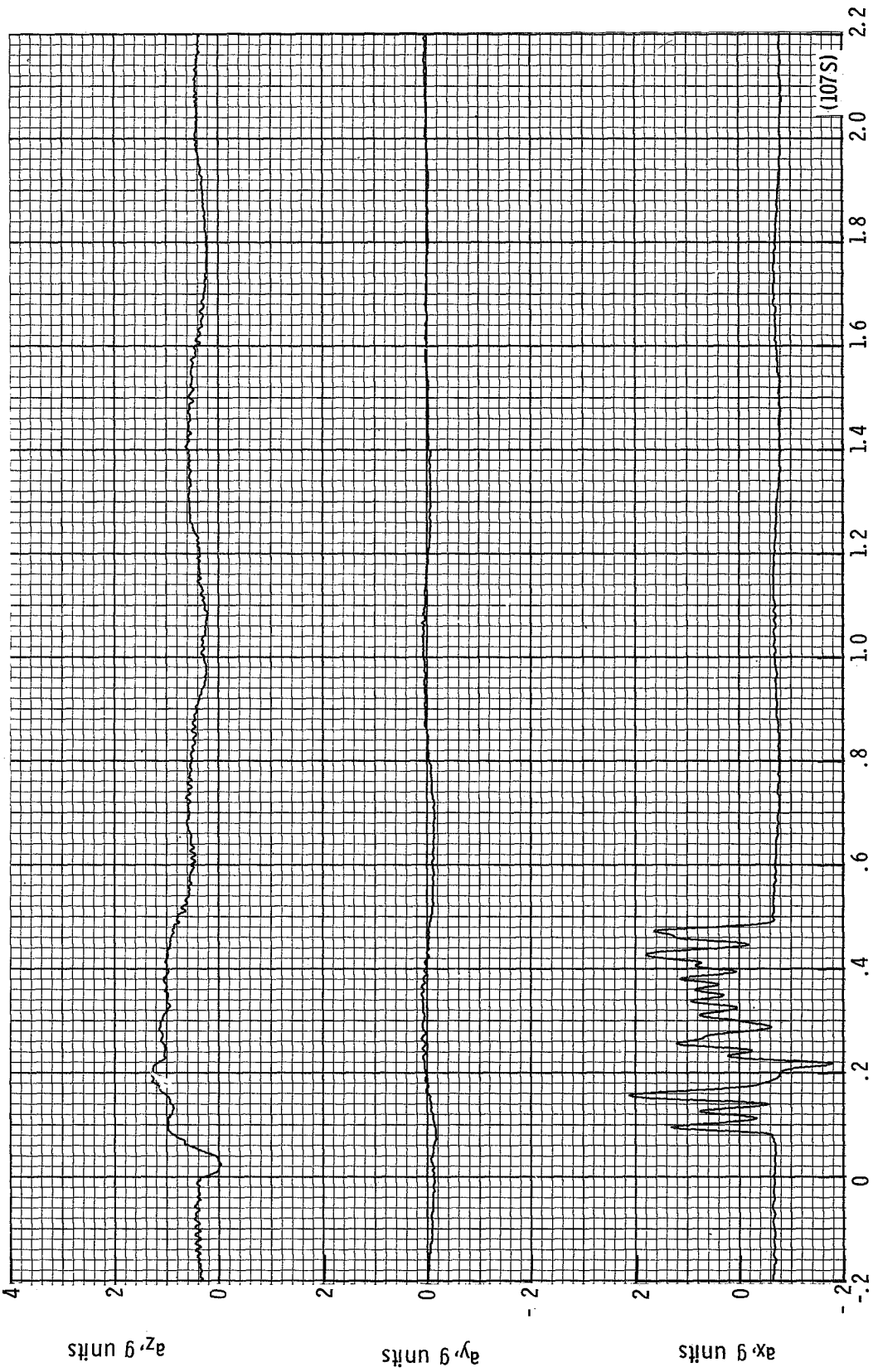
(p) Individual suspension-line loads F_{Lie4} and F_{Lie6} plotted against time from third-stage disreef. Time = 0 second corresponds to 38.80 seconds after launch.

Figure 21.- Continued.



(q) Individual suspension-line loads F_{k12} and F_{L1e2} plotted against time from third-stage disreef. Time = 0 second corresponds to 38.80 seconds after launch.

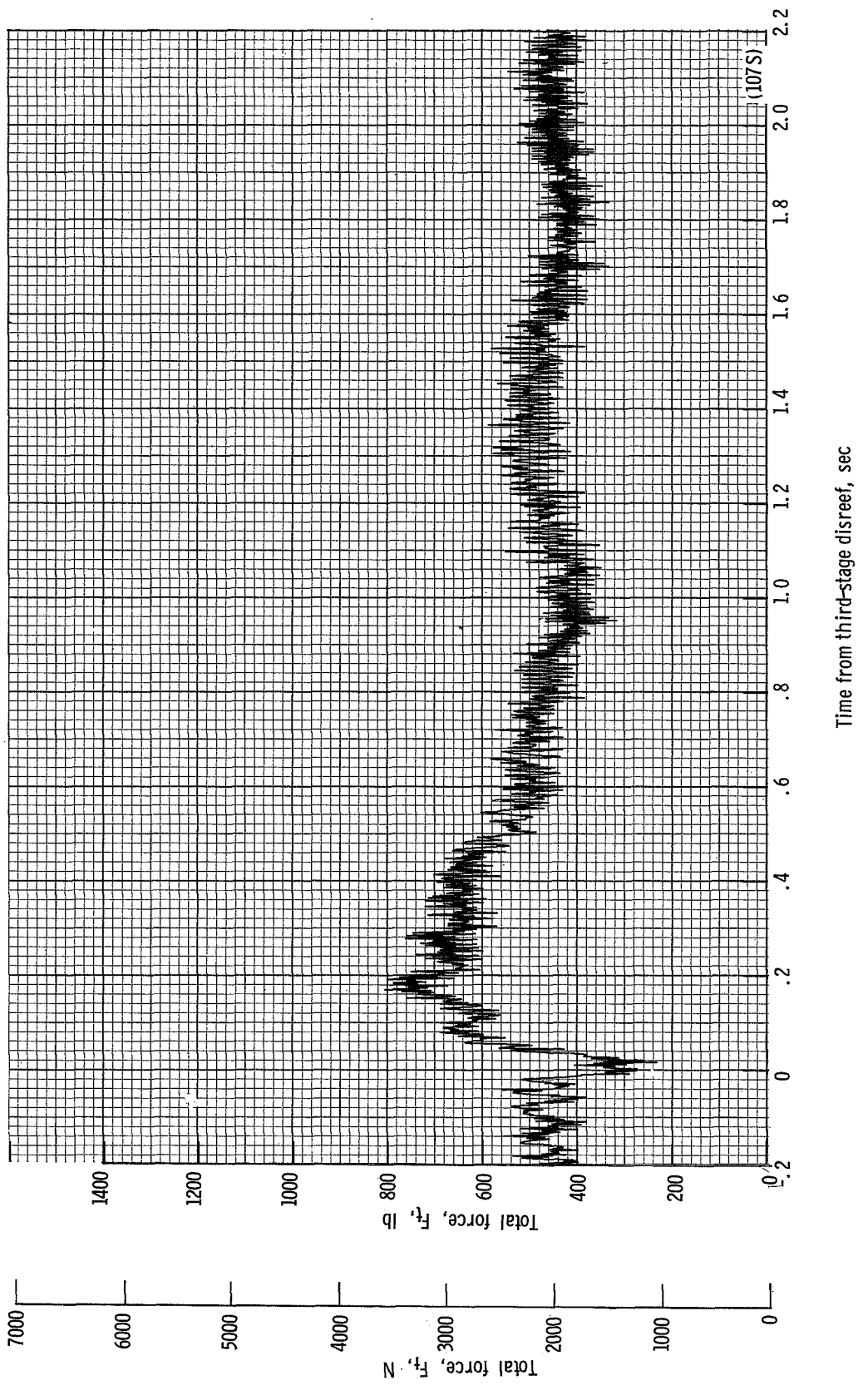
Figure 21.- Continued.



Time from third-stage disreef, sec

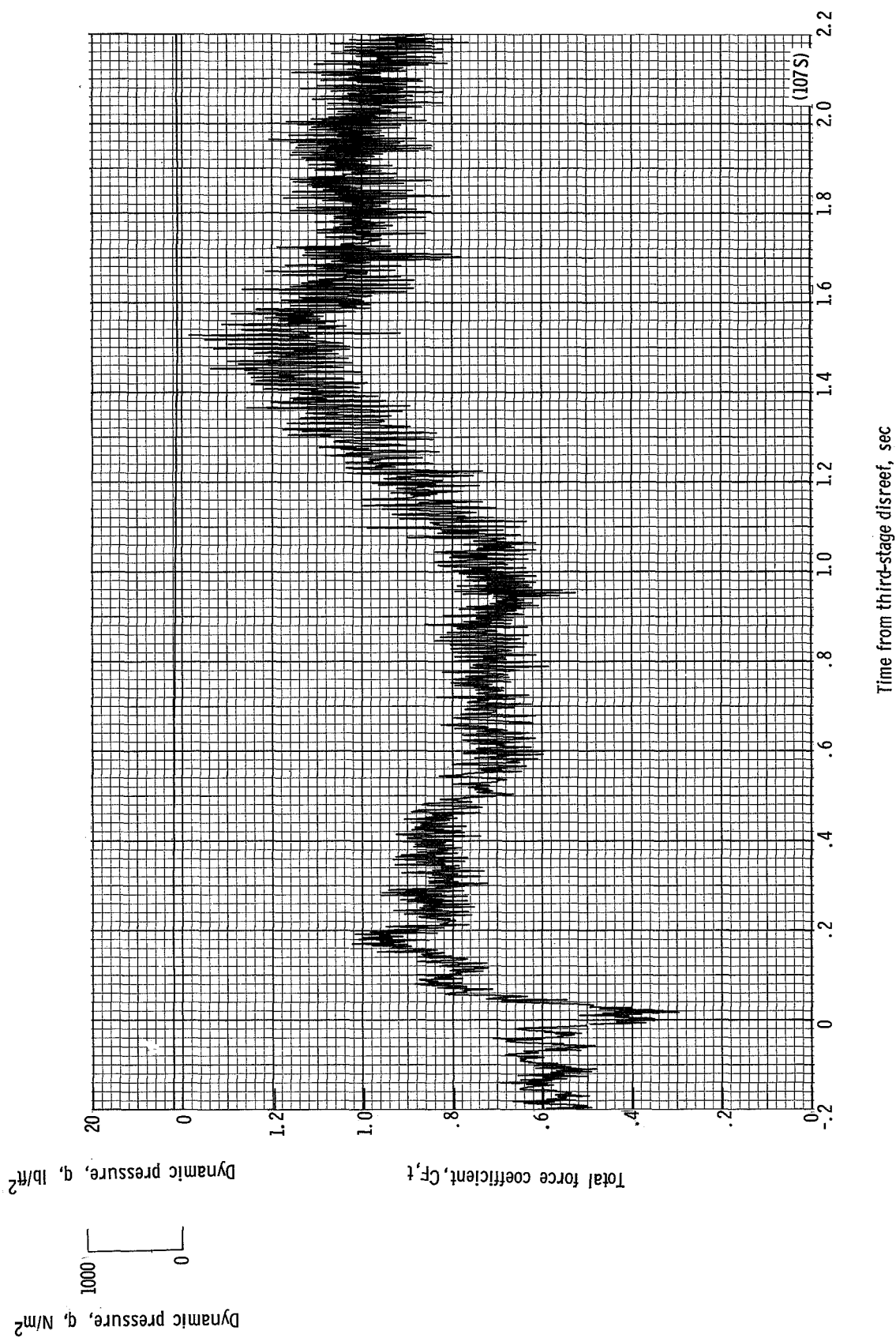
(r) Accelerations a_x , a_y , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 38.80 seconds after launch.

Figure 21.- Continued.



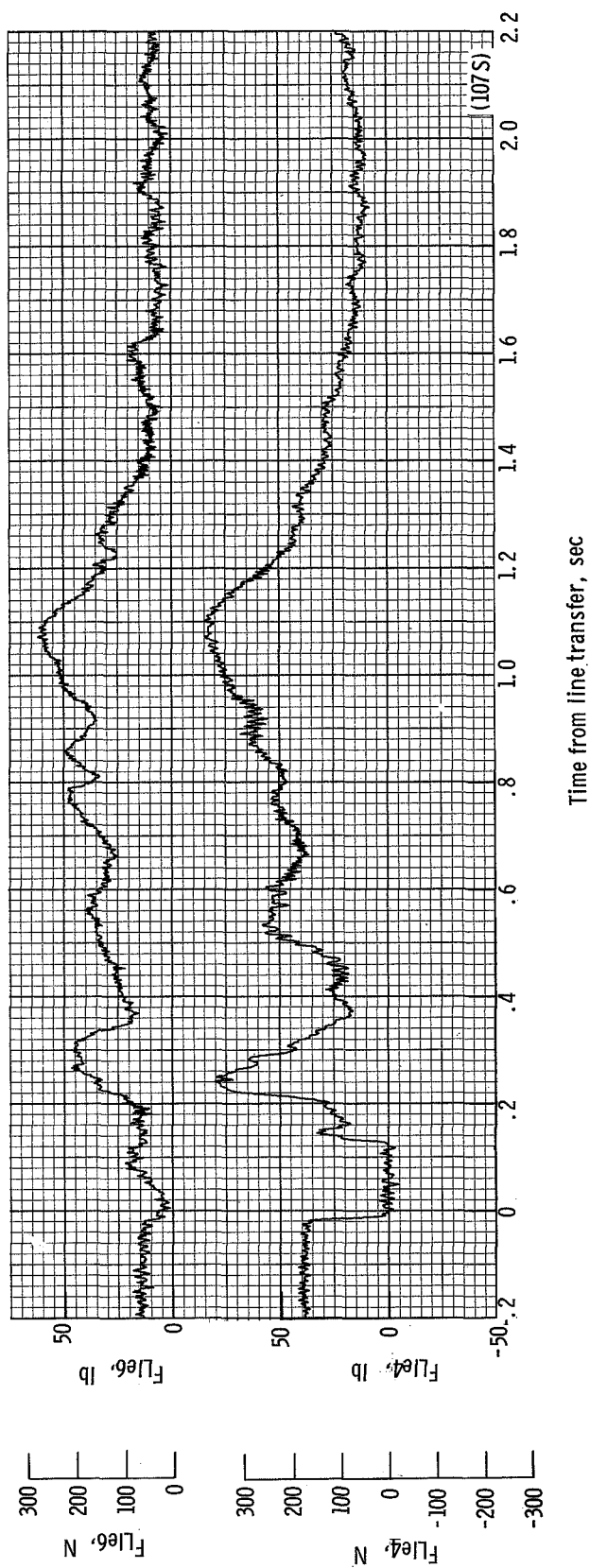
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 38.80 seconds after launch.

Figure 21.- Continued.



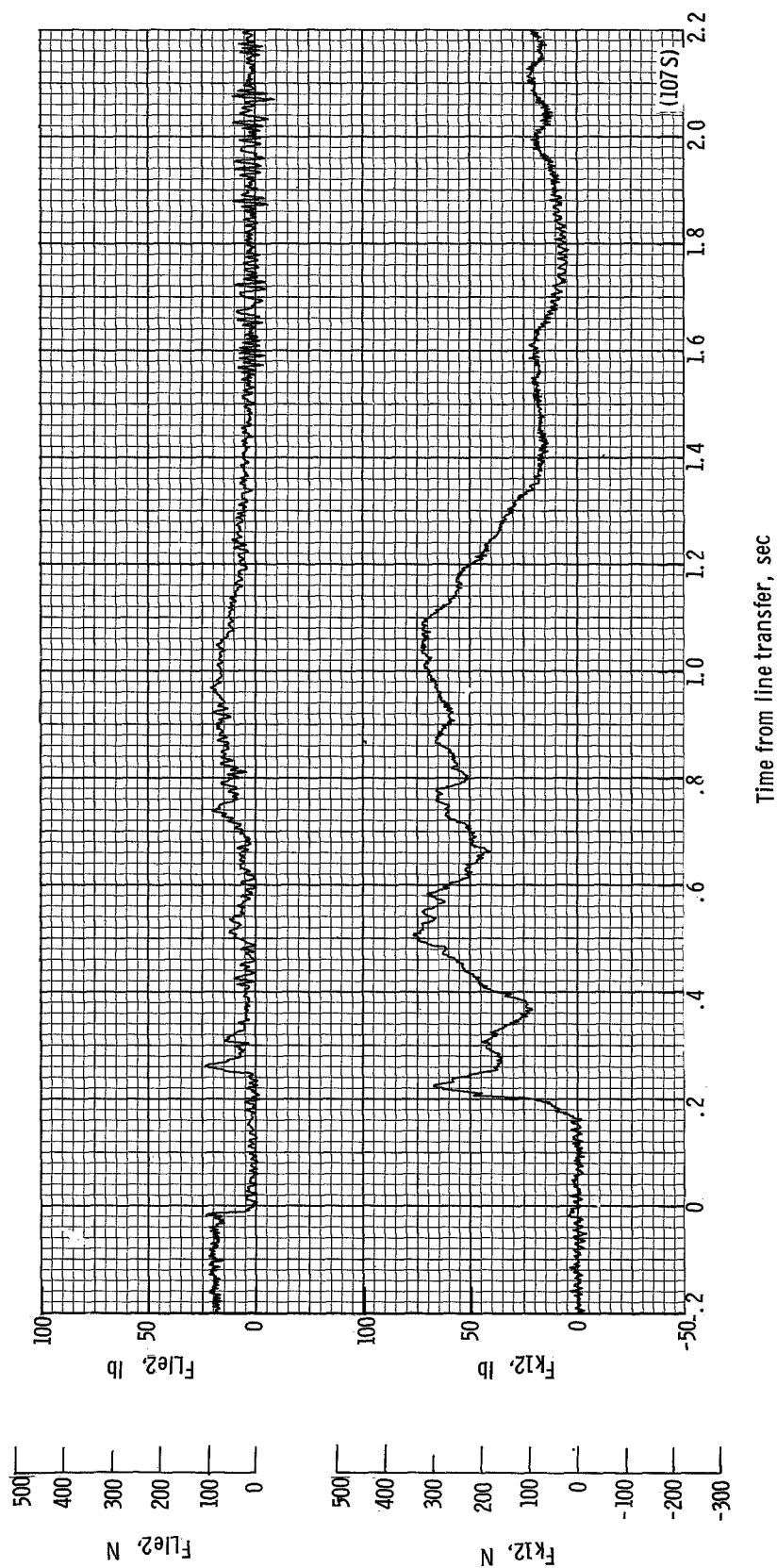
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 38.80 seconds after launch.

Figure 21.- Continued.



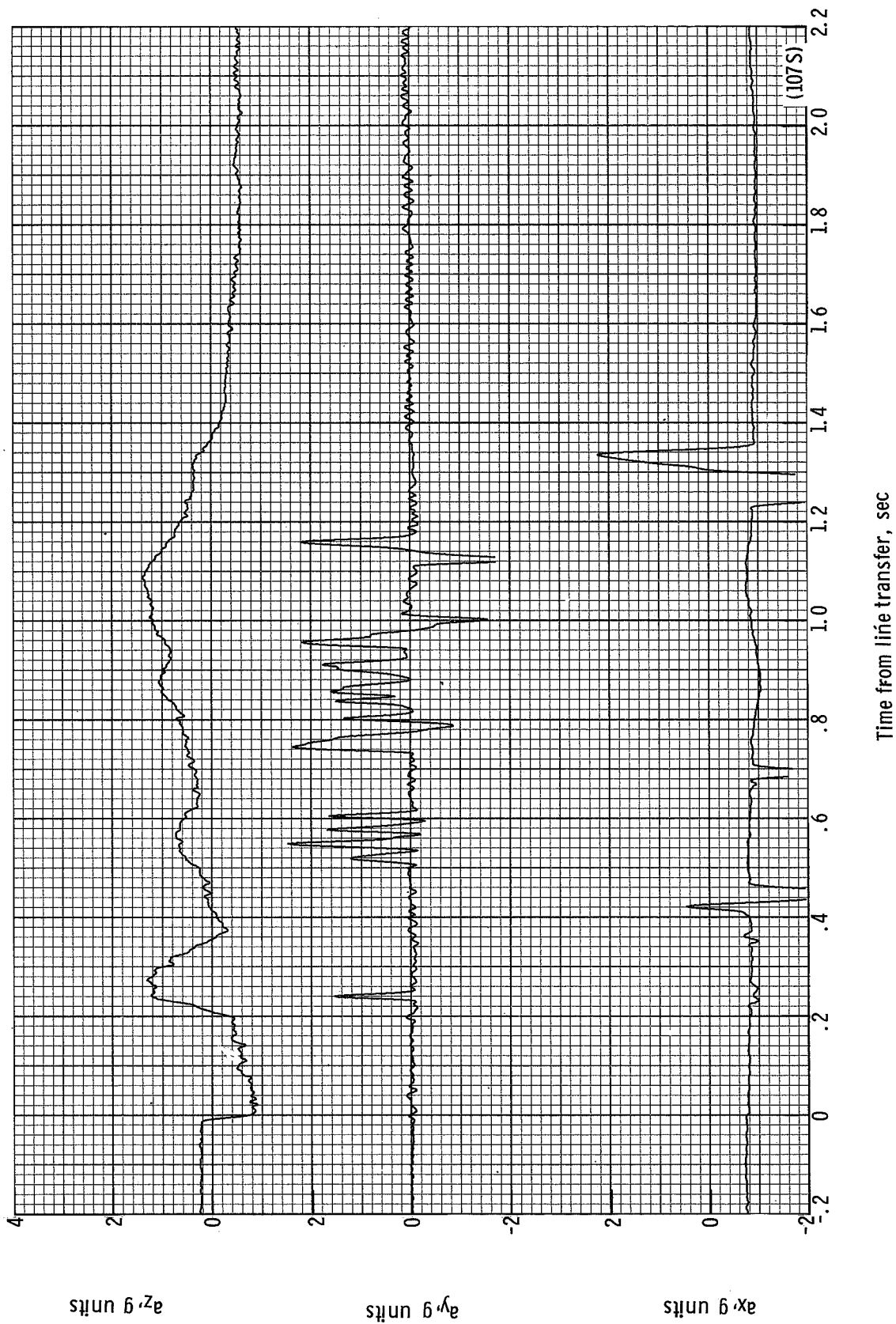
(u) Individual suspension-line loads F_{Lle4} and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 42.42 seconds after launch.

Figure 21.- Continued.



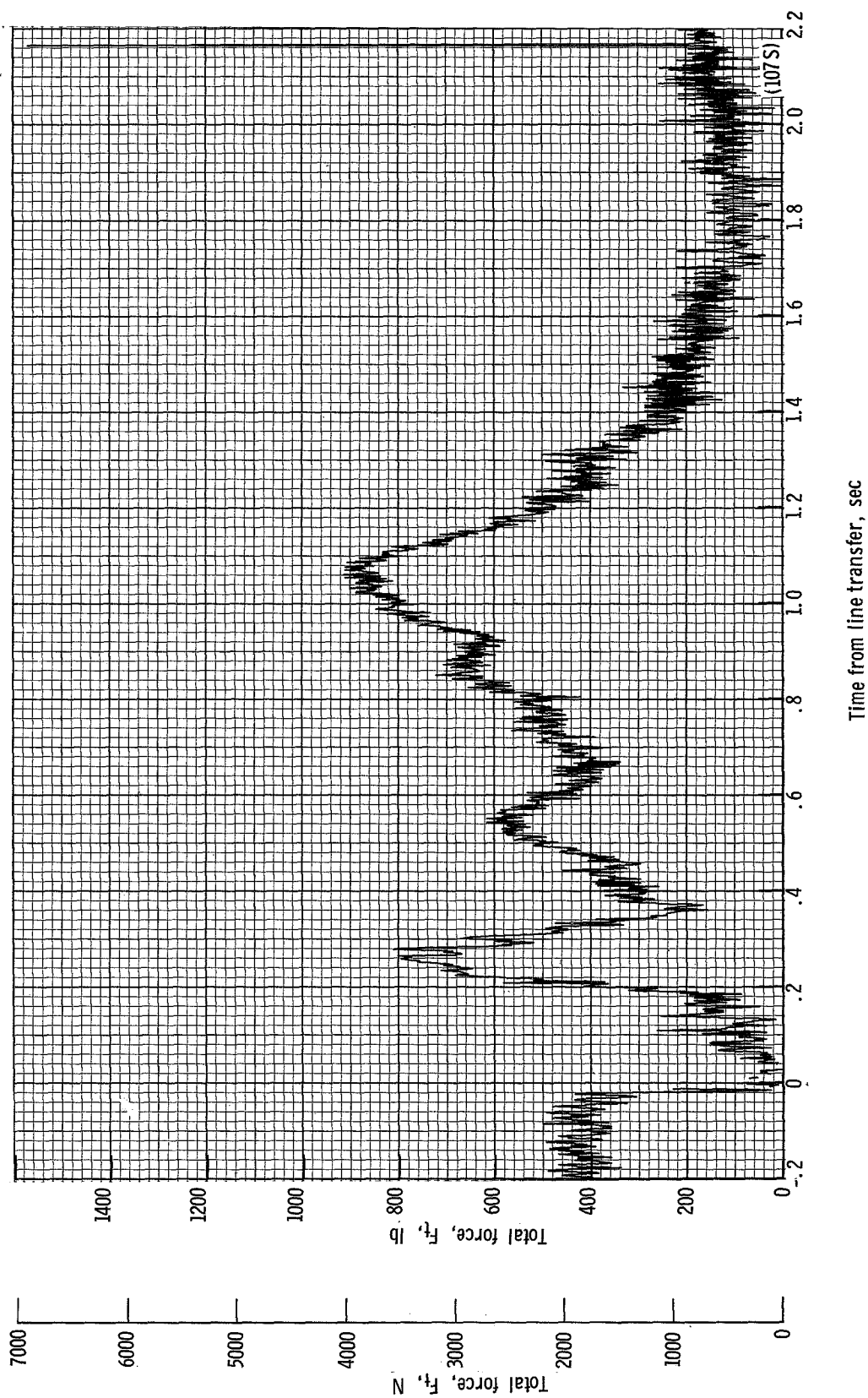
(v) Individual suspension-line loads F_{k12} and F_{Lie2} plotted against time from line transfer. Time = 0 second corresponds to 42.42 seconds after launch.

Figure 21.- Continued.



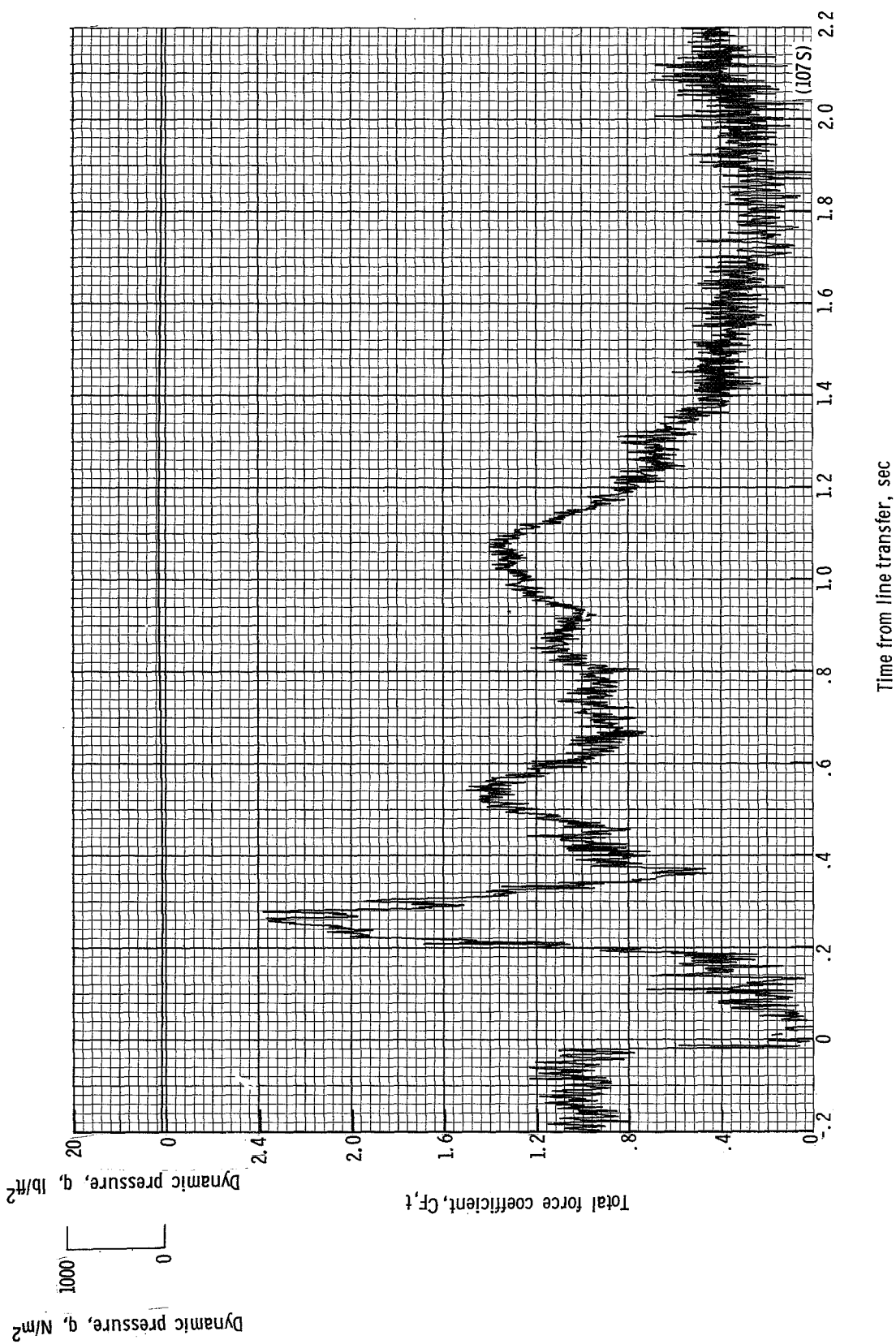
(w) Accelerations a_x , a_y , and a_z plotted against time from line transfer. Time = 0 second corresponds to 42.42 seconds after launch.

Figure 21.- Continued.



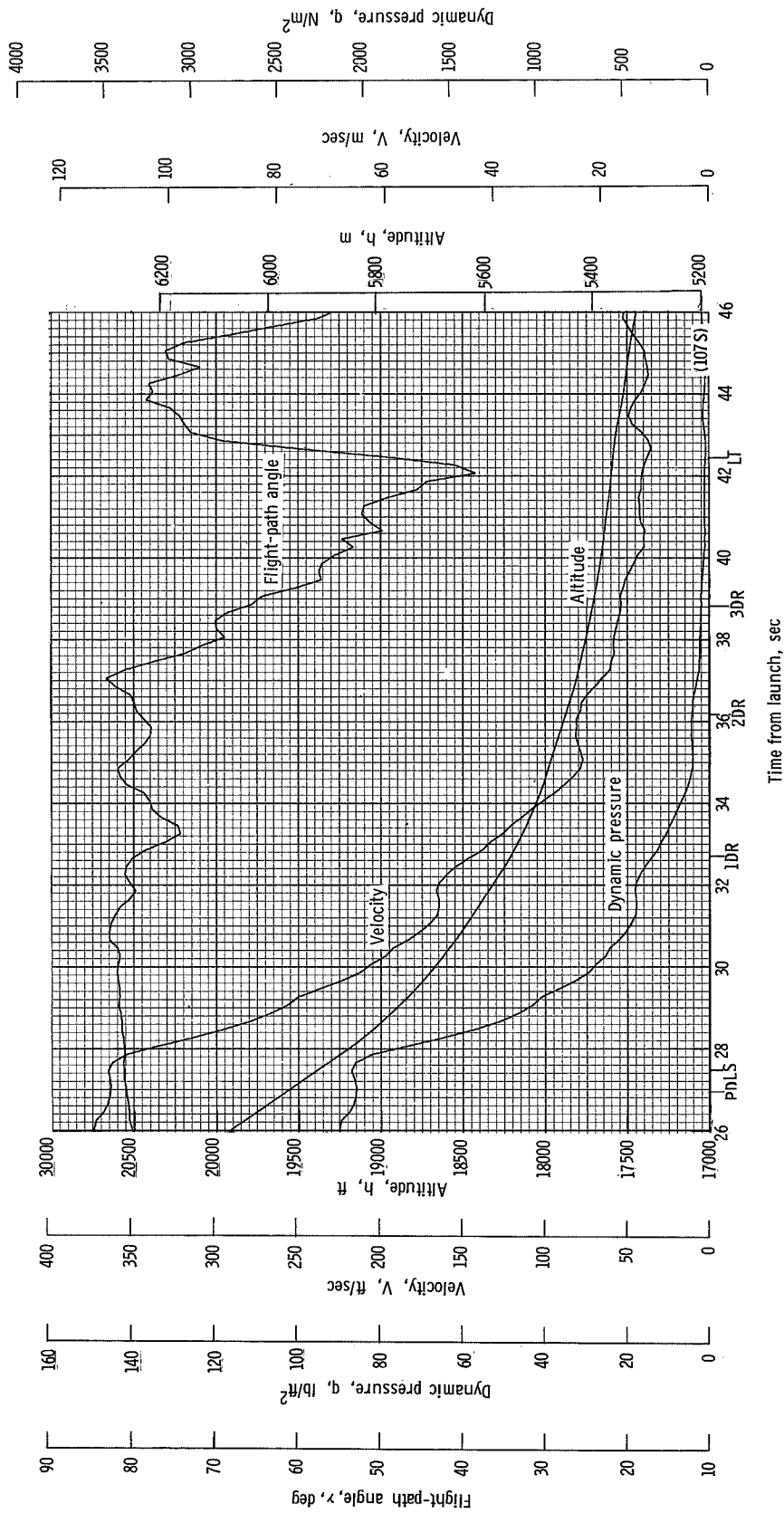
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 42.42 seconds after launch.

Figure 21.- Continued.



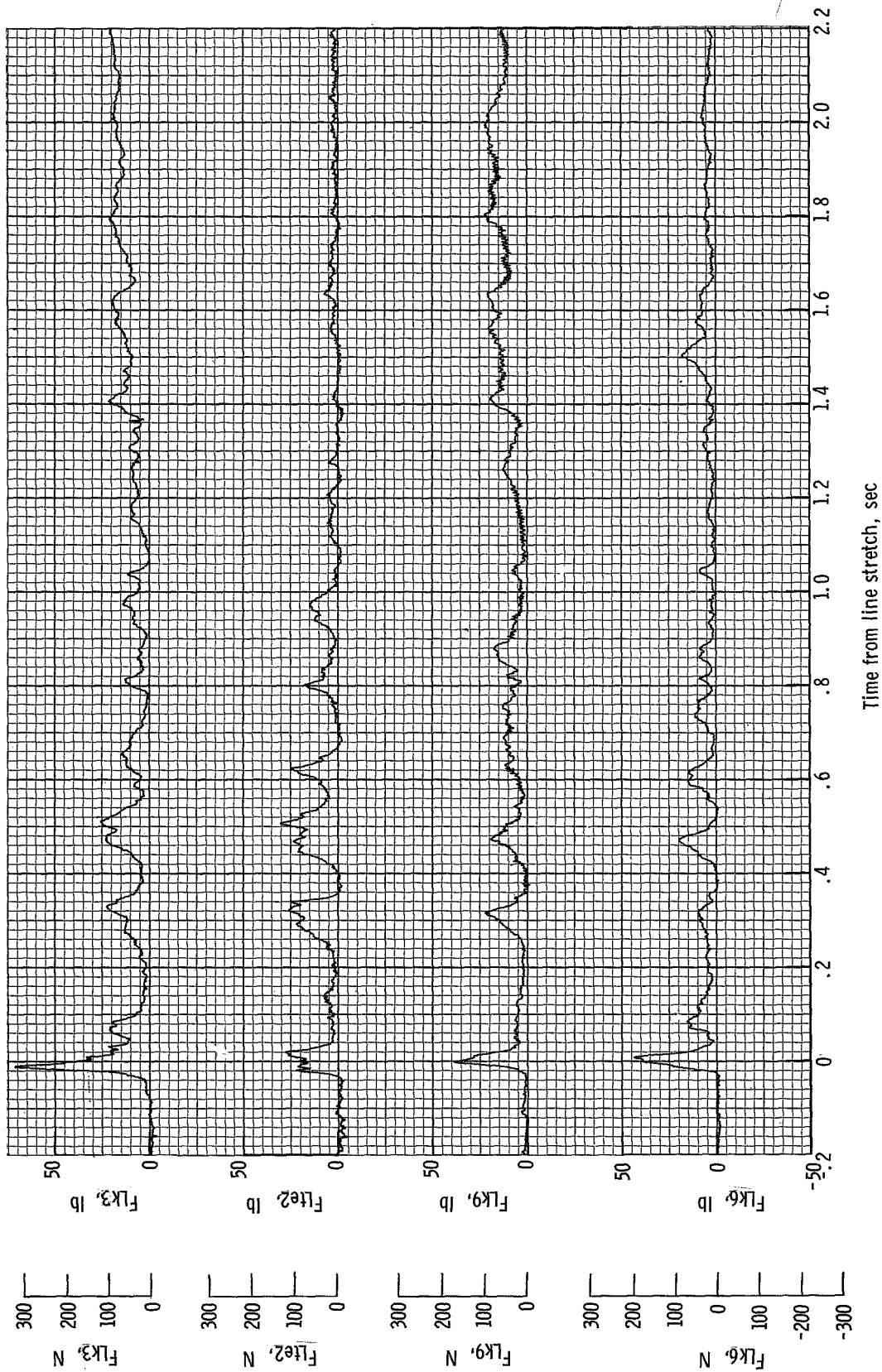
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 42.42 seconds after launch.

Figure 21.- Continued.



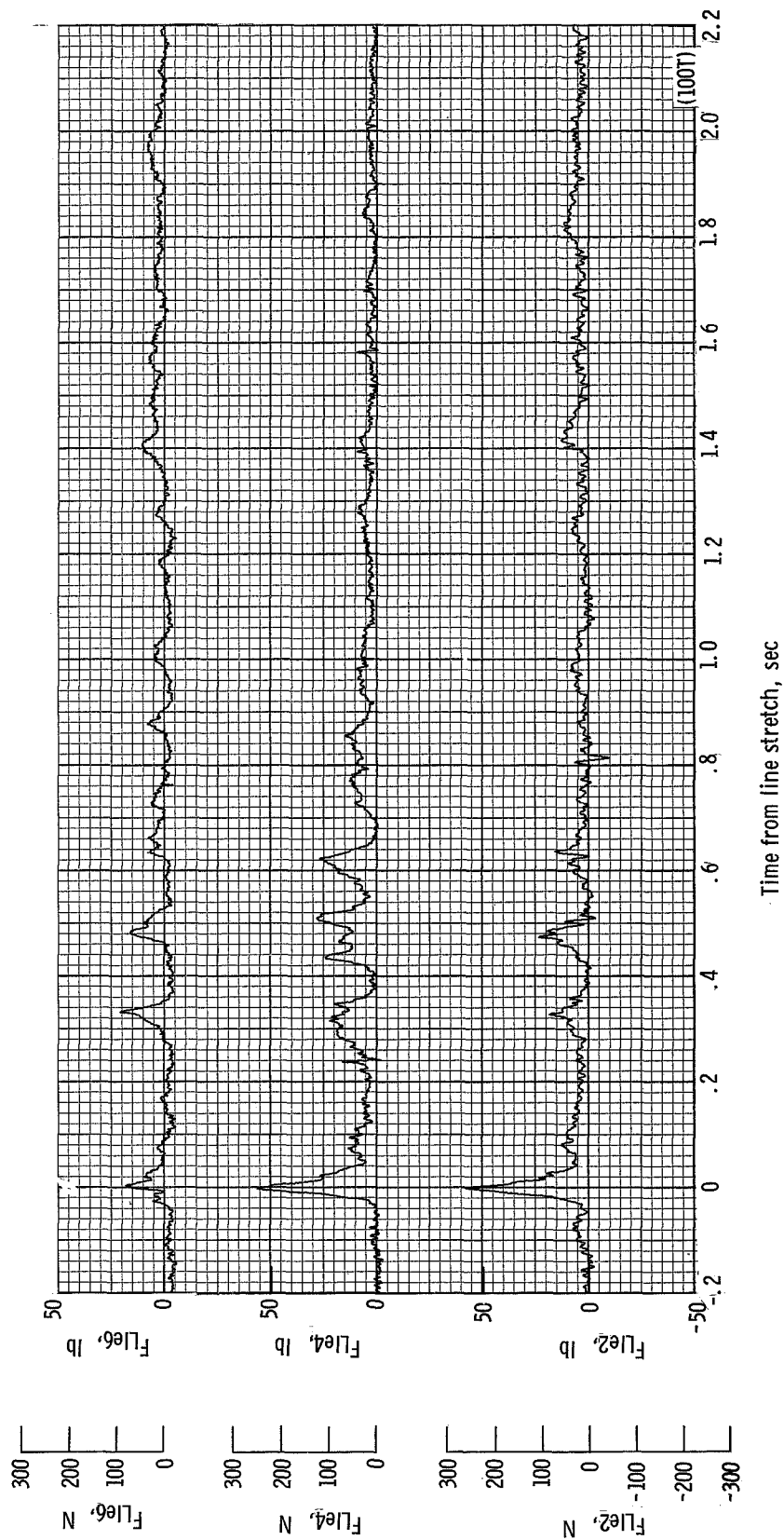
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 21.- Concluded.



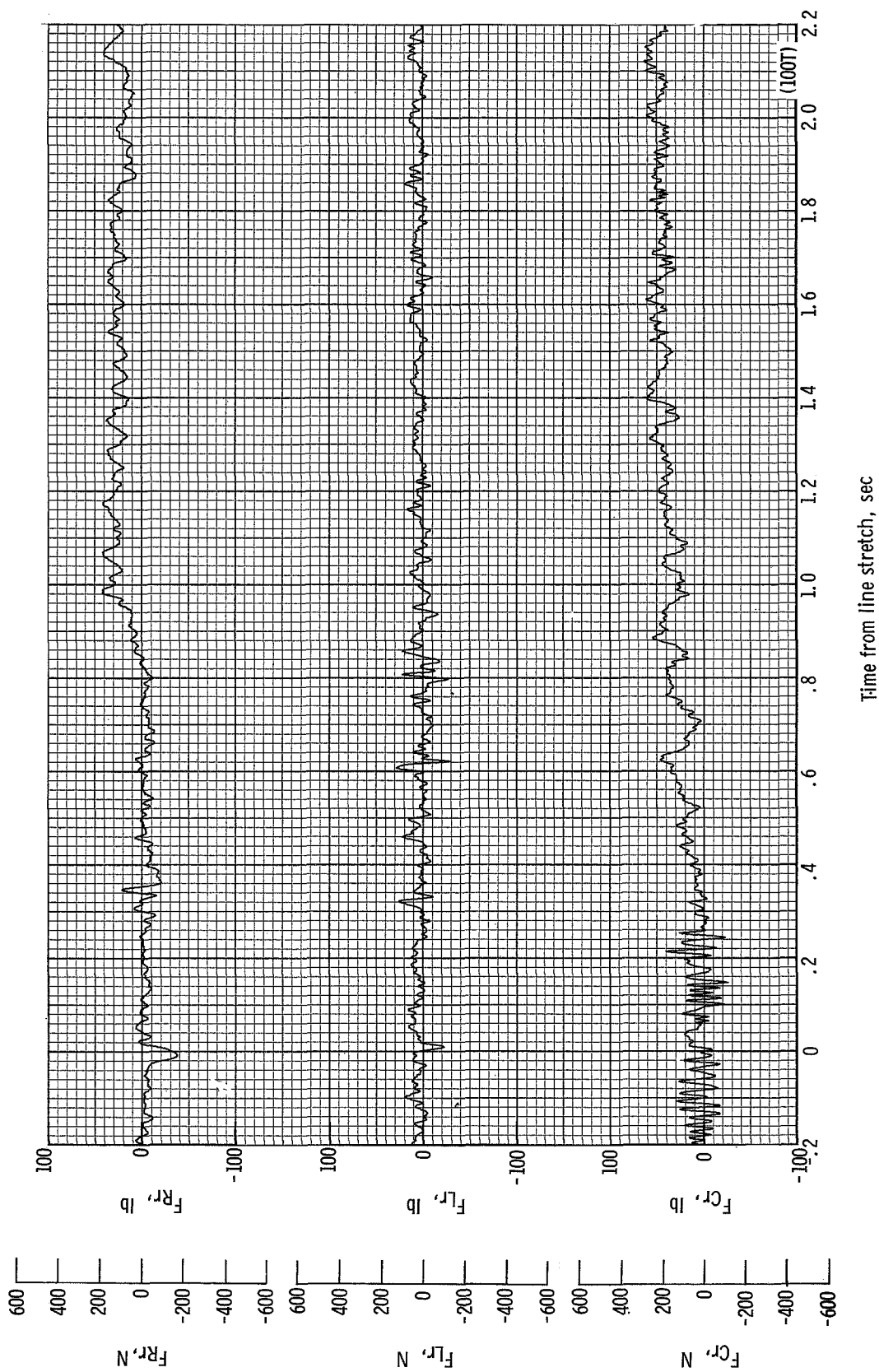
(a) Individual suspension-line loads F_{LK6} , F_{LK9} , F_{Lte2} , and F_{LK3} plotted against time from line stretch. Time = 0 second corresponds to 27.26 seconds after launch.

Figure 22.- Time history of twin-keel parawing deployment data for test 100T. $W_D = 962.3 \text{ N}$ (216.3 lb); $W_P = 795.6 \text{ N}$ (178.9 lb); $q_{PD} = 1695 \text{ N/m}^2$ (35.4 lb/ft²); $h_{PD} = 3362 \text{ m}$ (11 030 ft); $L_r/L_k = 0.167$; reefing version 1.



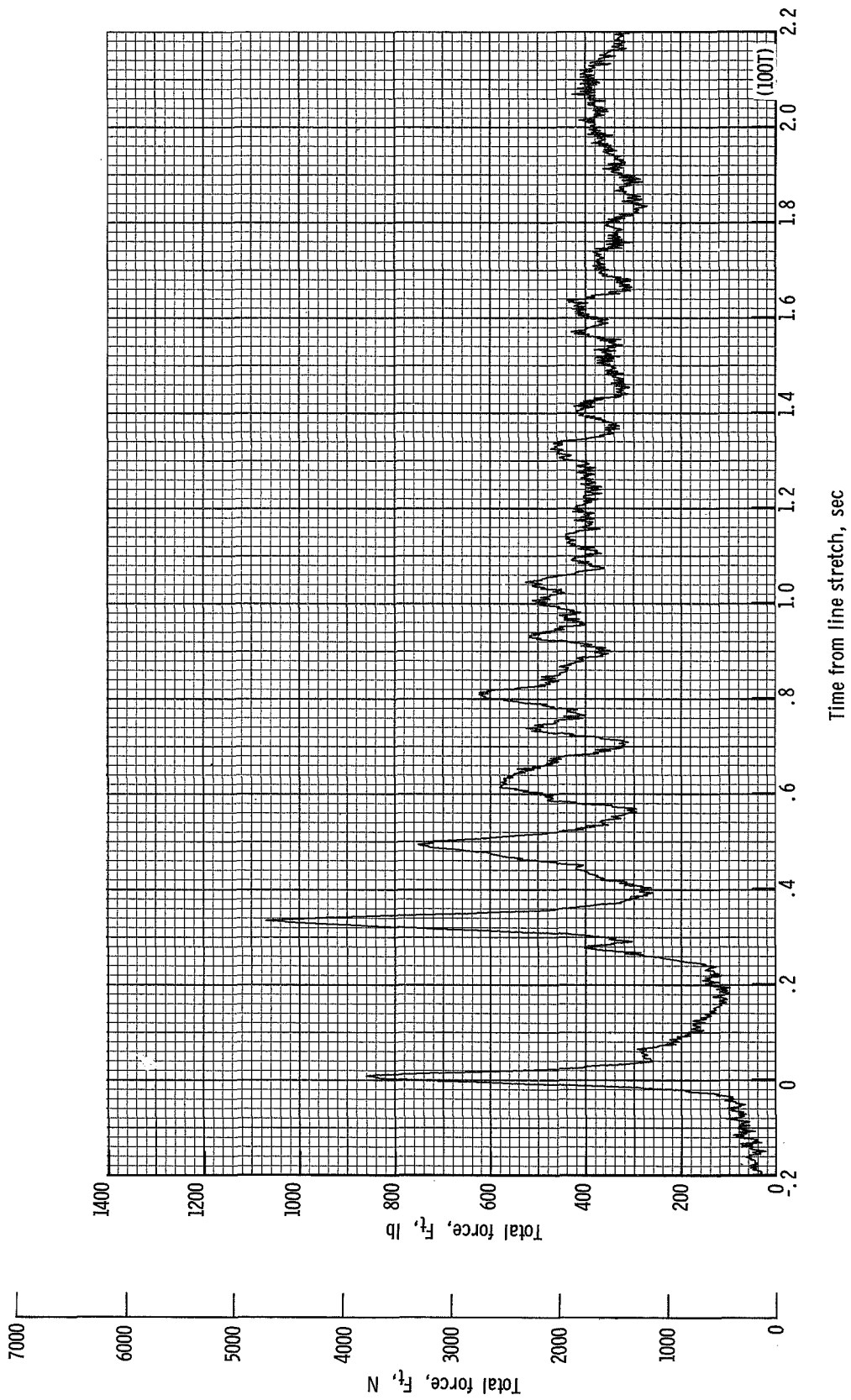
(b) Individual suspension-line loads F_{Lie2} , F_{Lie4} , and F_{Lie6} plotted against time from line stretch. Time = 0 second corresponds to 27.26 seconds after launch.

Figure 22.- Continued.



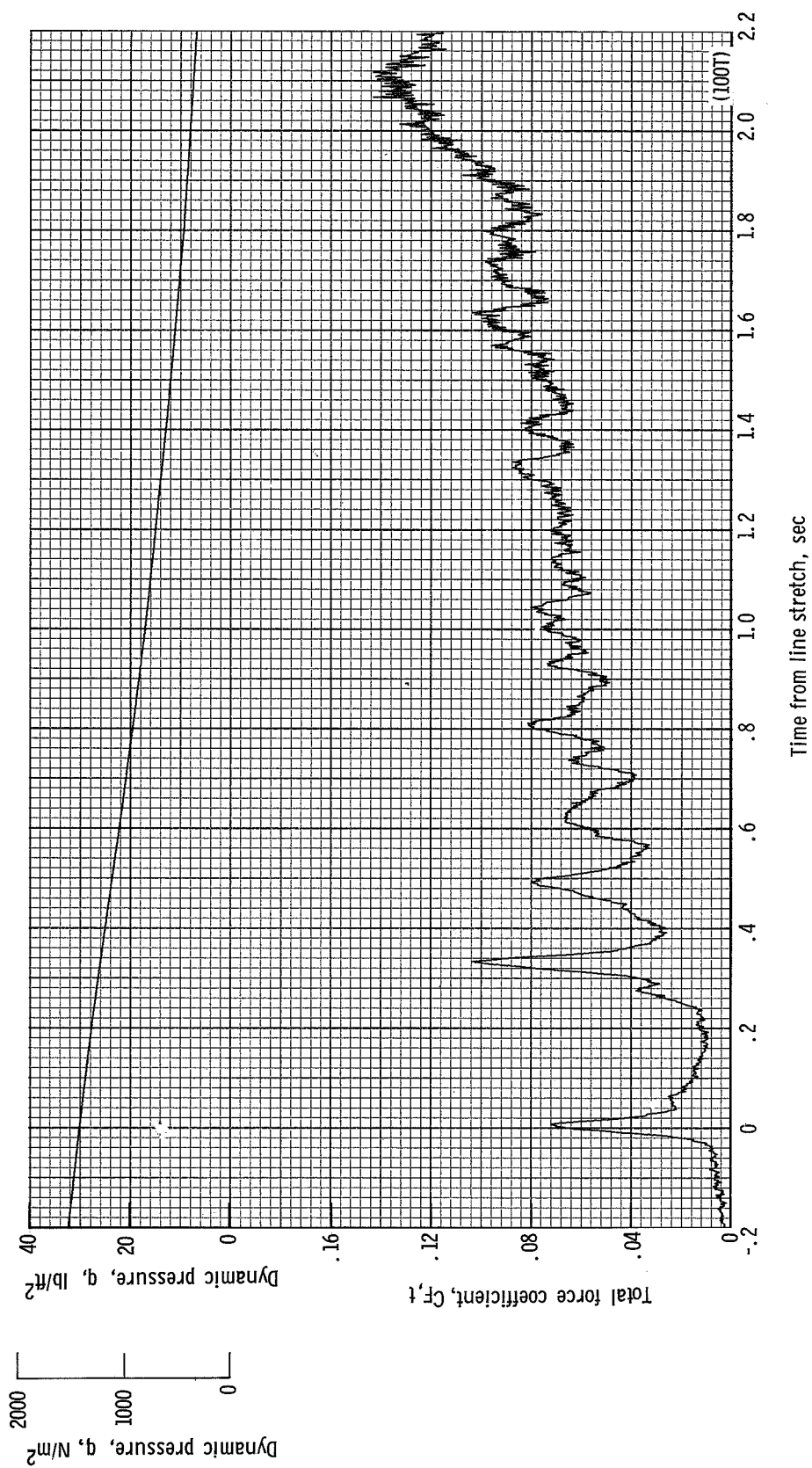
(c) Individual reefing-line loads F_{Cr} , F_{Lr} , F_{Rl} plotted against time from line stretch. Time = 0 second corresponds to 27.26 seconds after launch.

Figure 22.- Continued.



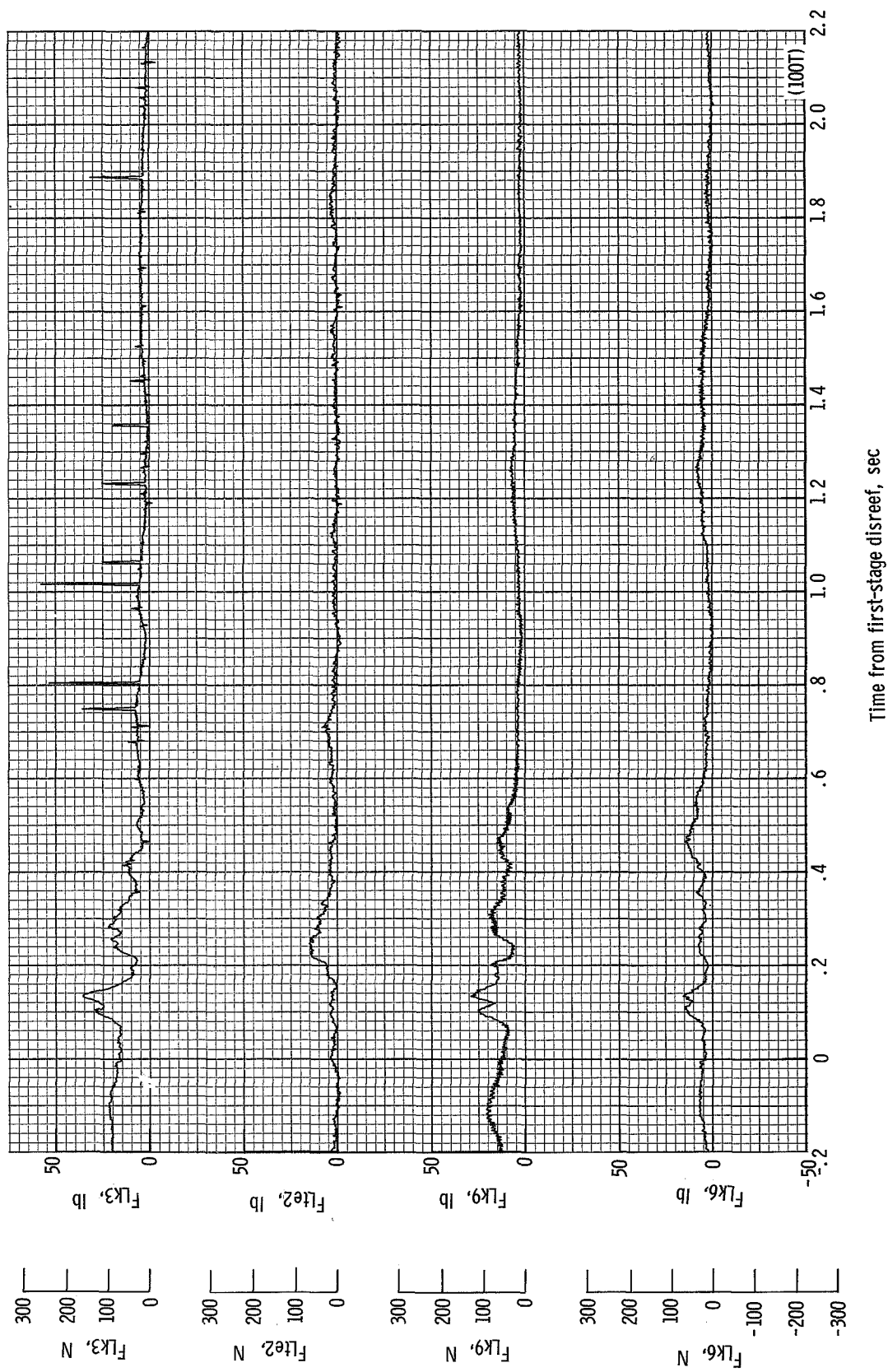
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds at 27.26 seconds after launch.

Figure 22.- Continued.



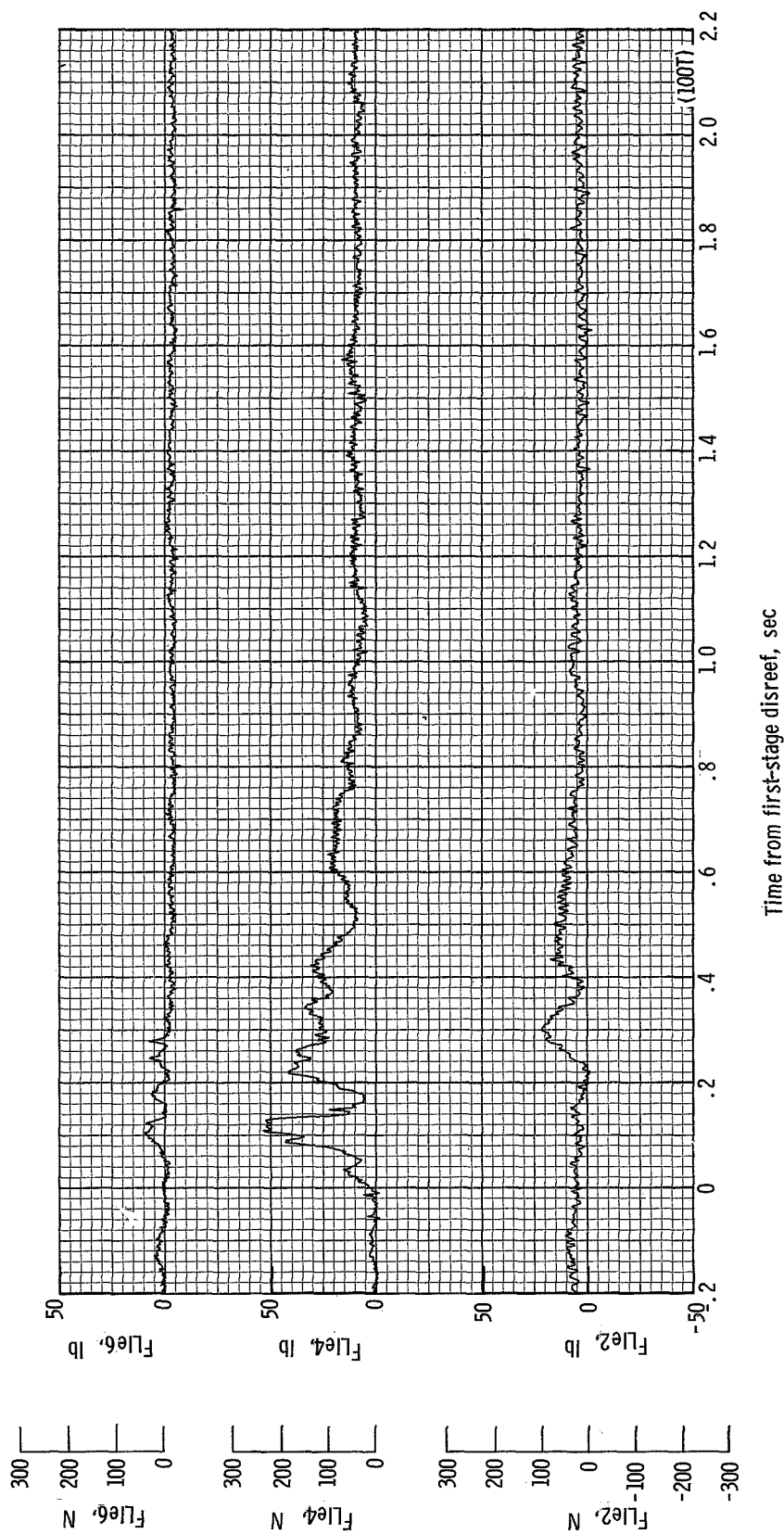
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 27.26 seconds after launch.

Figure 22.- Continued.



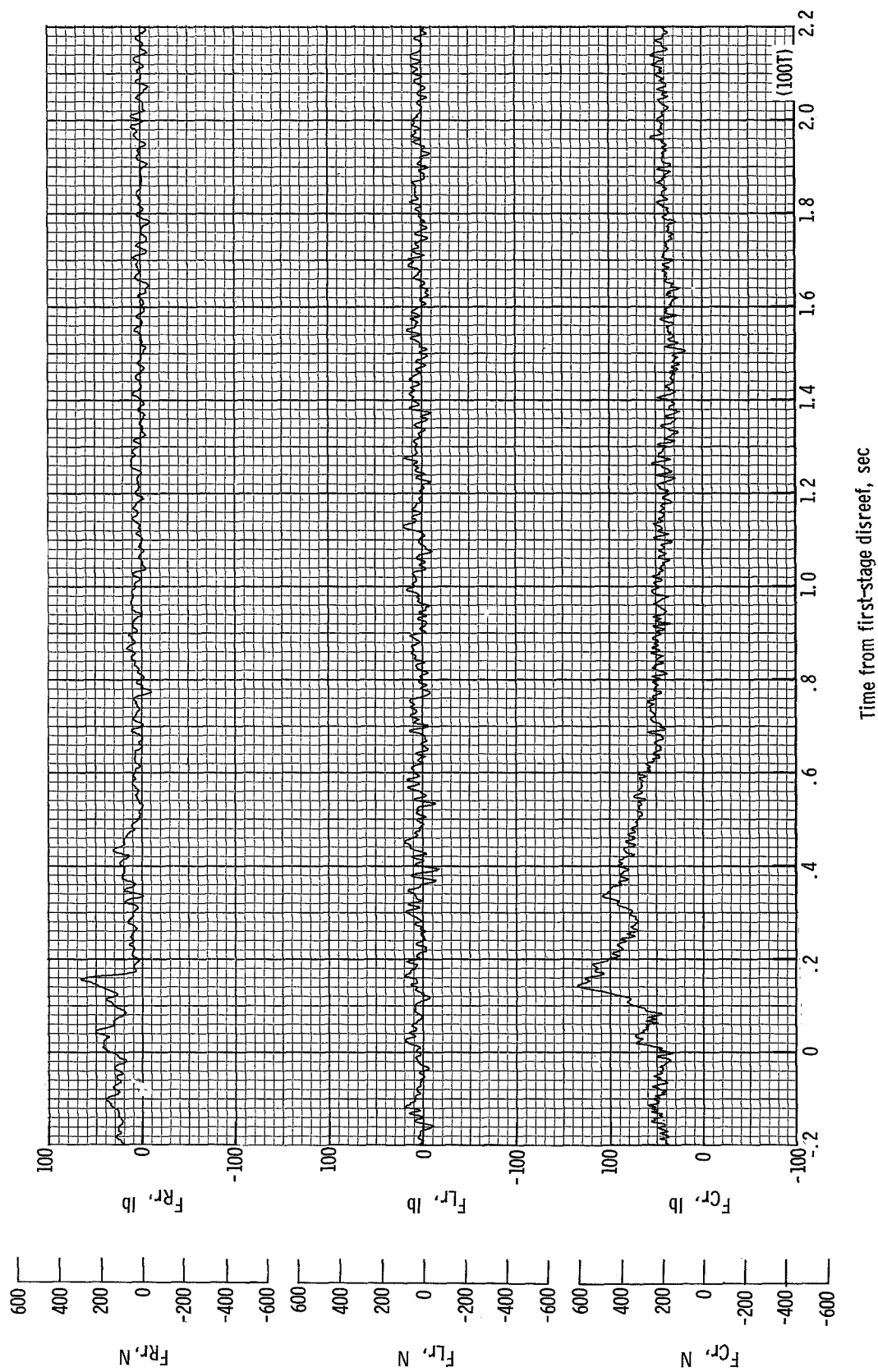
(f) Individual suspension-line loads F_{LK6} , F_{LK9} , F_{LT2} , and F_{LK3} plotted against time from first-stage disreef. Time = 0 second corresponds to 29.64 seconds after launch.

Figure 22.- Continued.



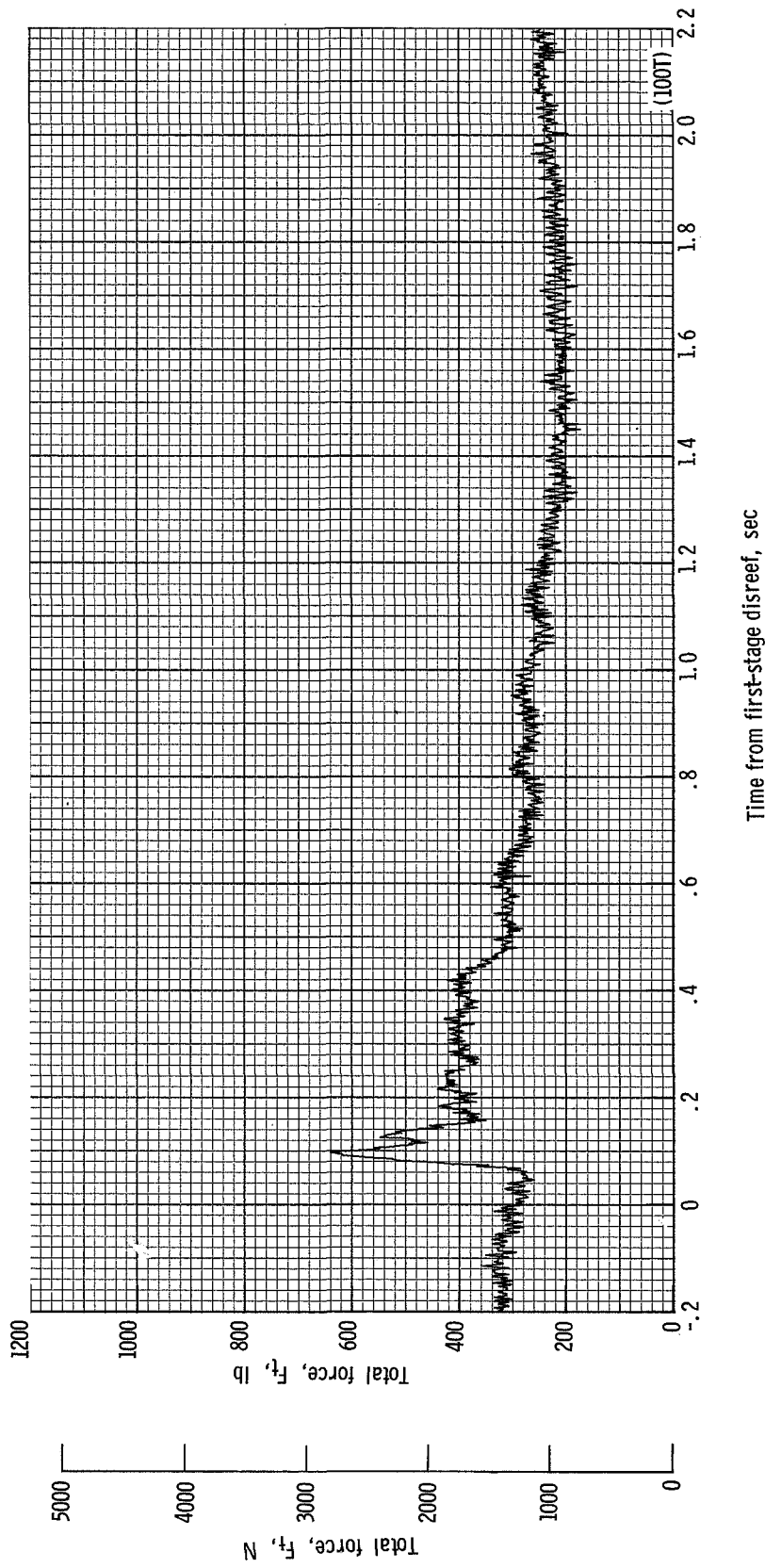
(g) Individual suspension-line loads F_{Lle2} , F_{Lle4} , and F_{Lle6} plotted against time from first-stage disreef. Time = 0 second corresponds to 29.64 seconds after launch.

Figure 22.- Continued.



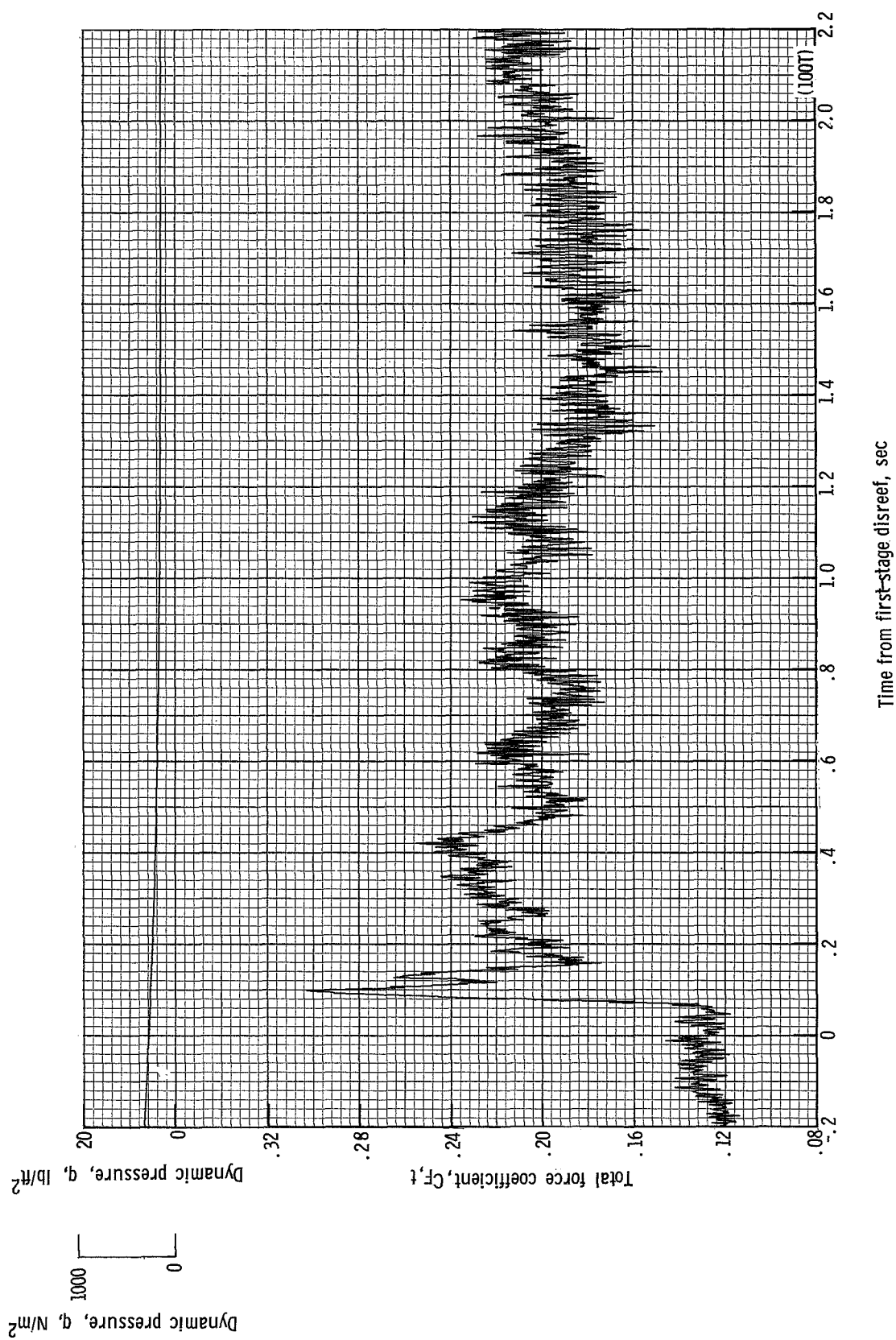
(h) Individual reefing-line loads F_{Cr} , F_L , F_R plotted against time from first-stage disreef. Time = 0 second corresponds to 29.64 seconds after launch.

Figure 22.- Continued.



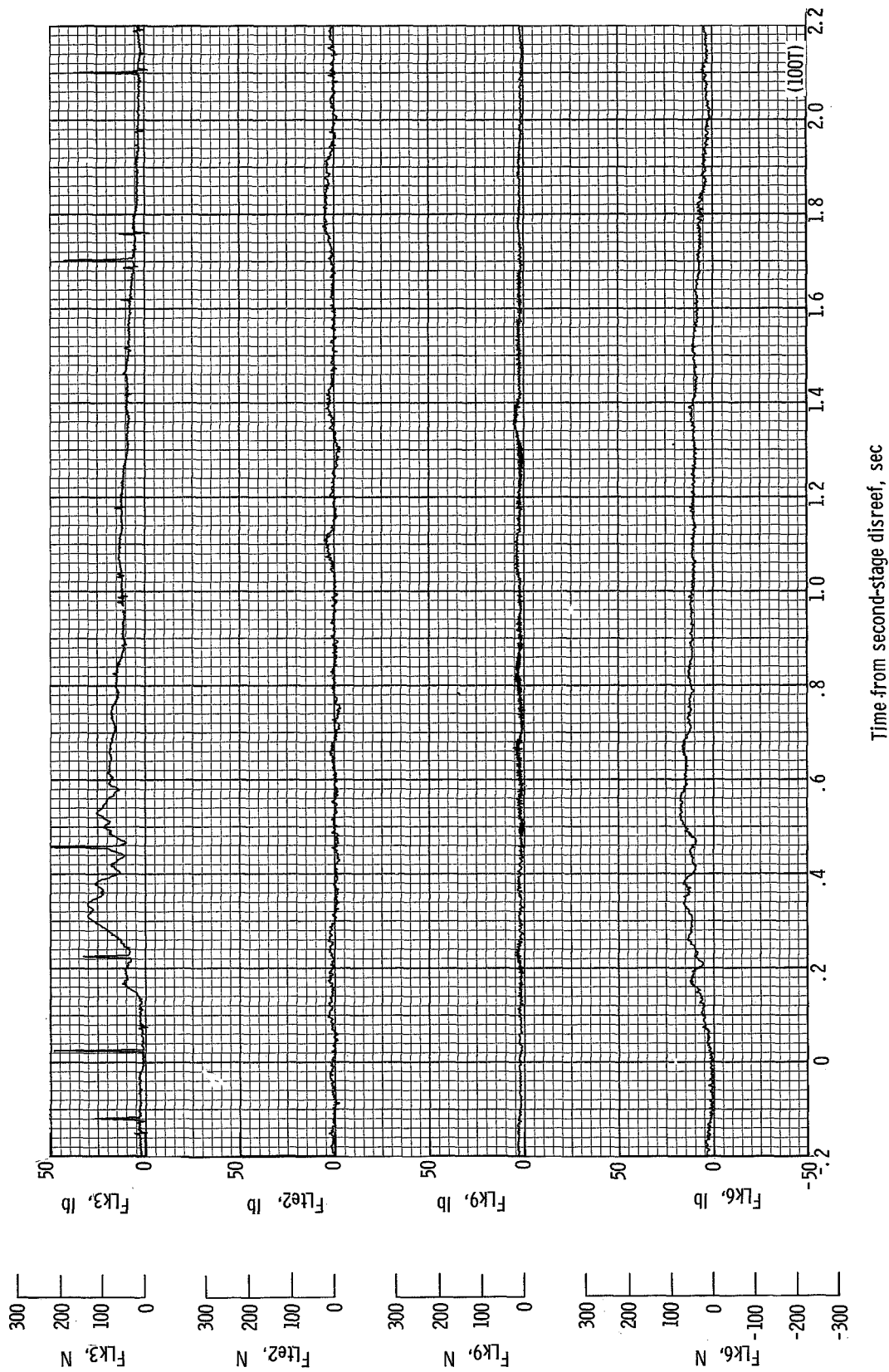
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 29.64 seconds after launch.

Figure 22.- Continued.



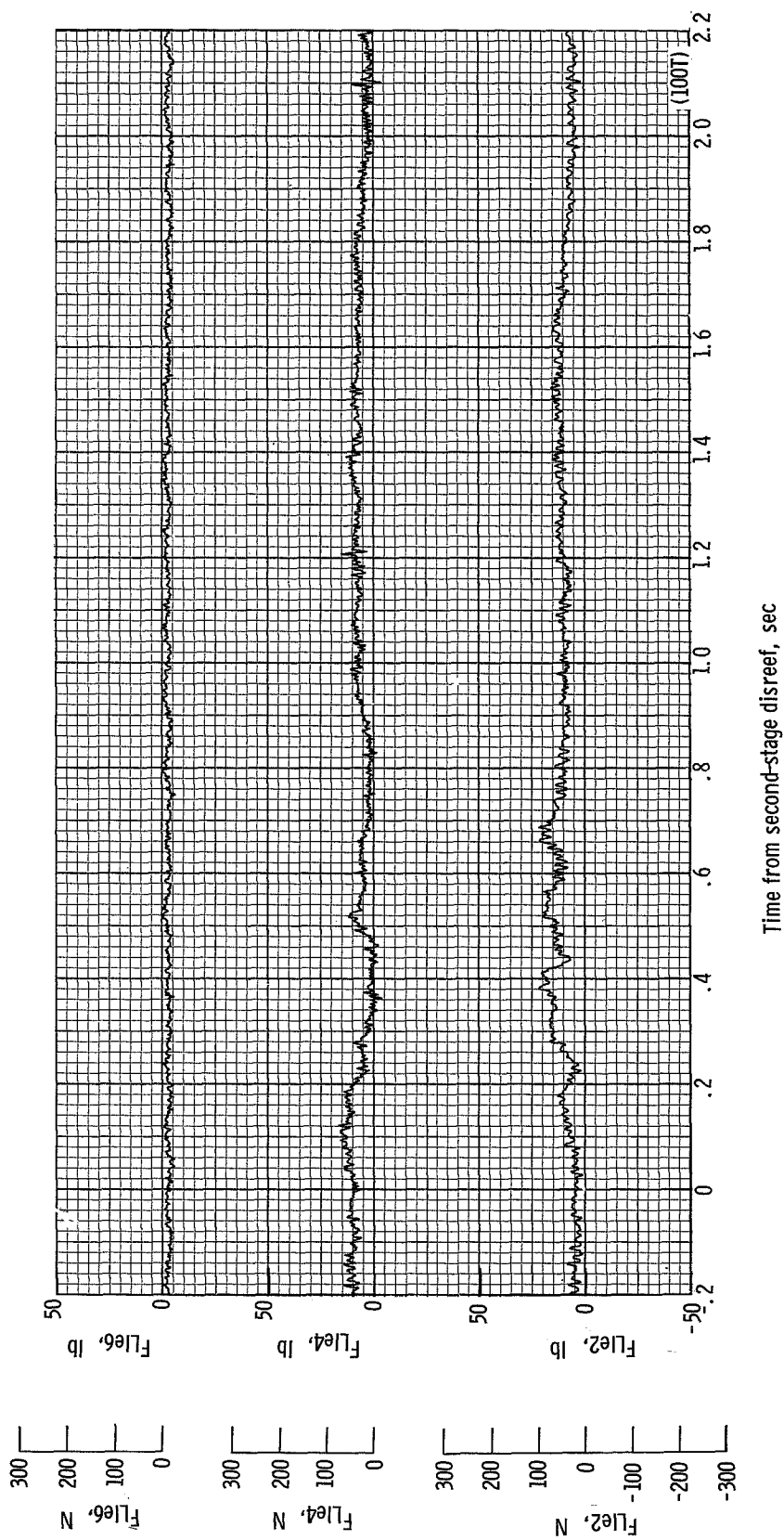
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 29.64 seconds after launch.

Figure 22.- Continued.



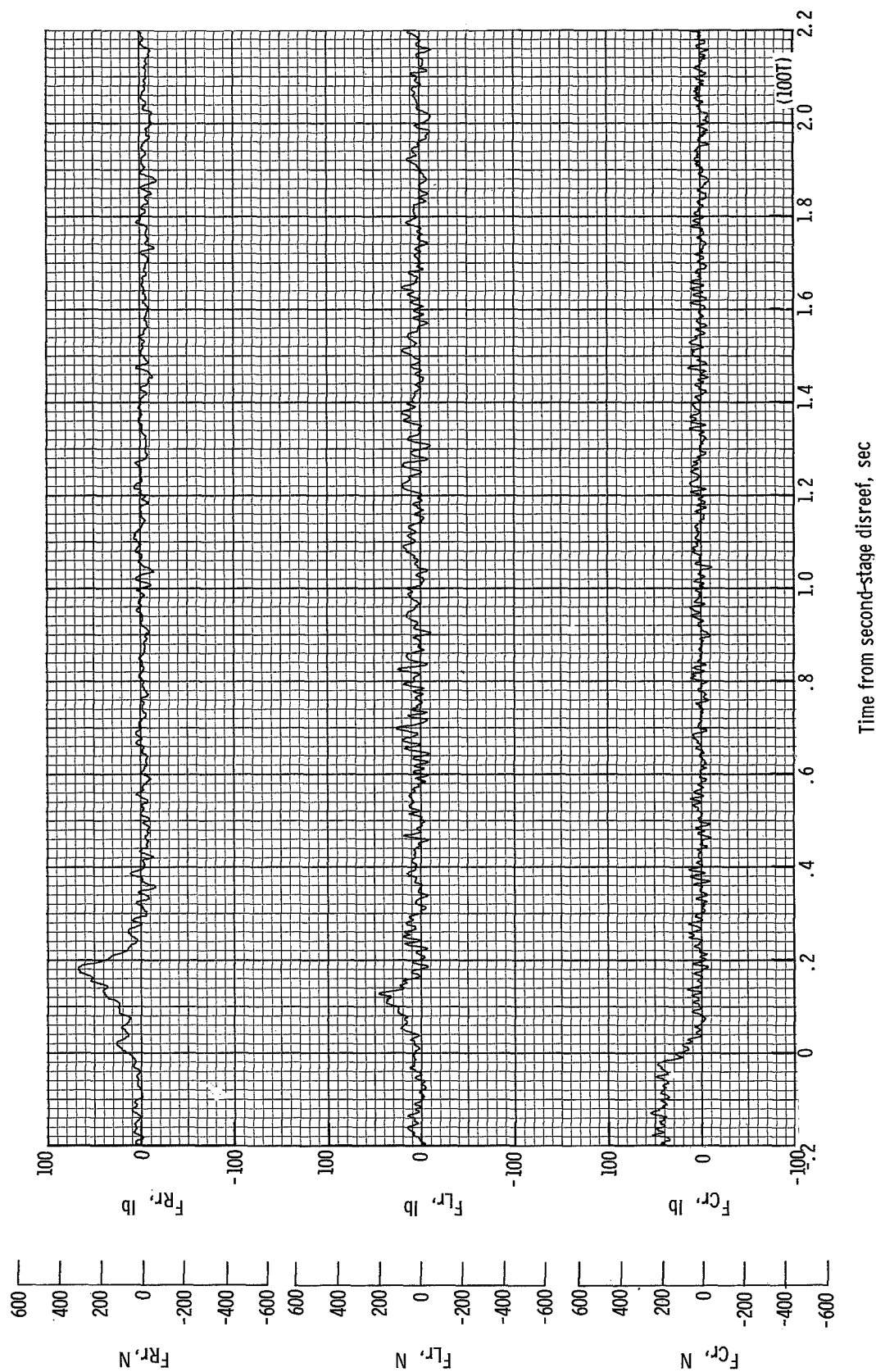
(k) Individual suspension-line loads F_{LK6} , F_{LK9} , F_{LTe2} , and F_{LK3} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.61 seconds after launch.

Figure 22.- Continued.



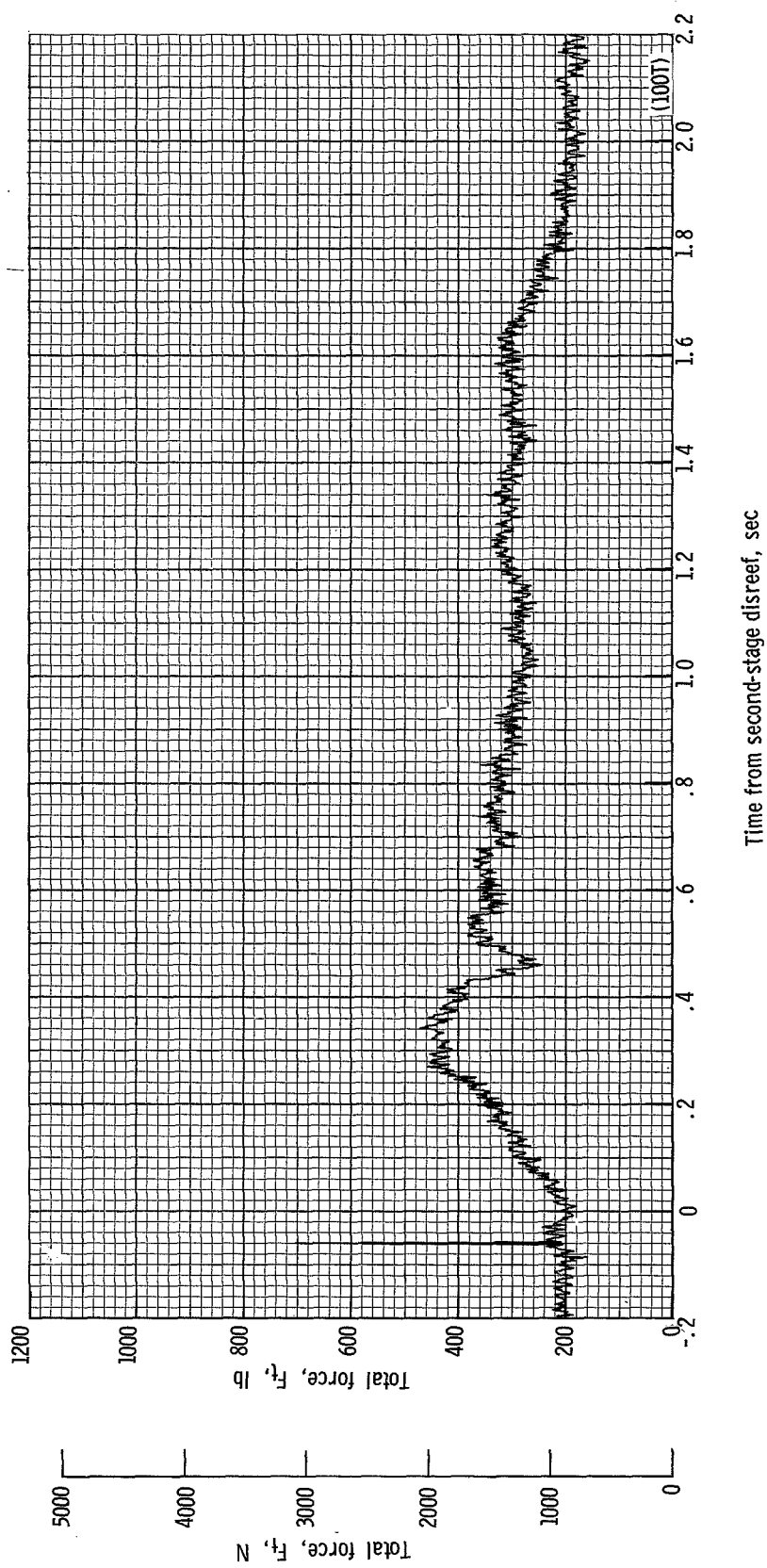
(1) Individual suspension-line loads F_{Lie2} , F_{Lie4} , and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.61 seconds after launch.

Figure 22.- Continued.



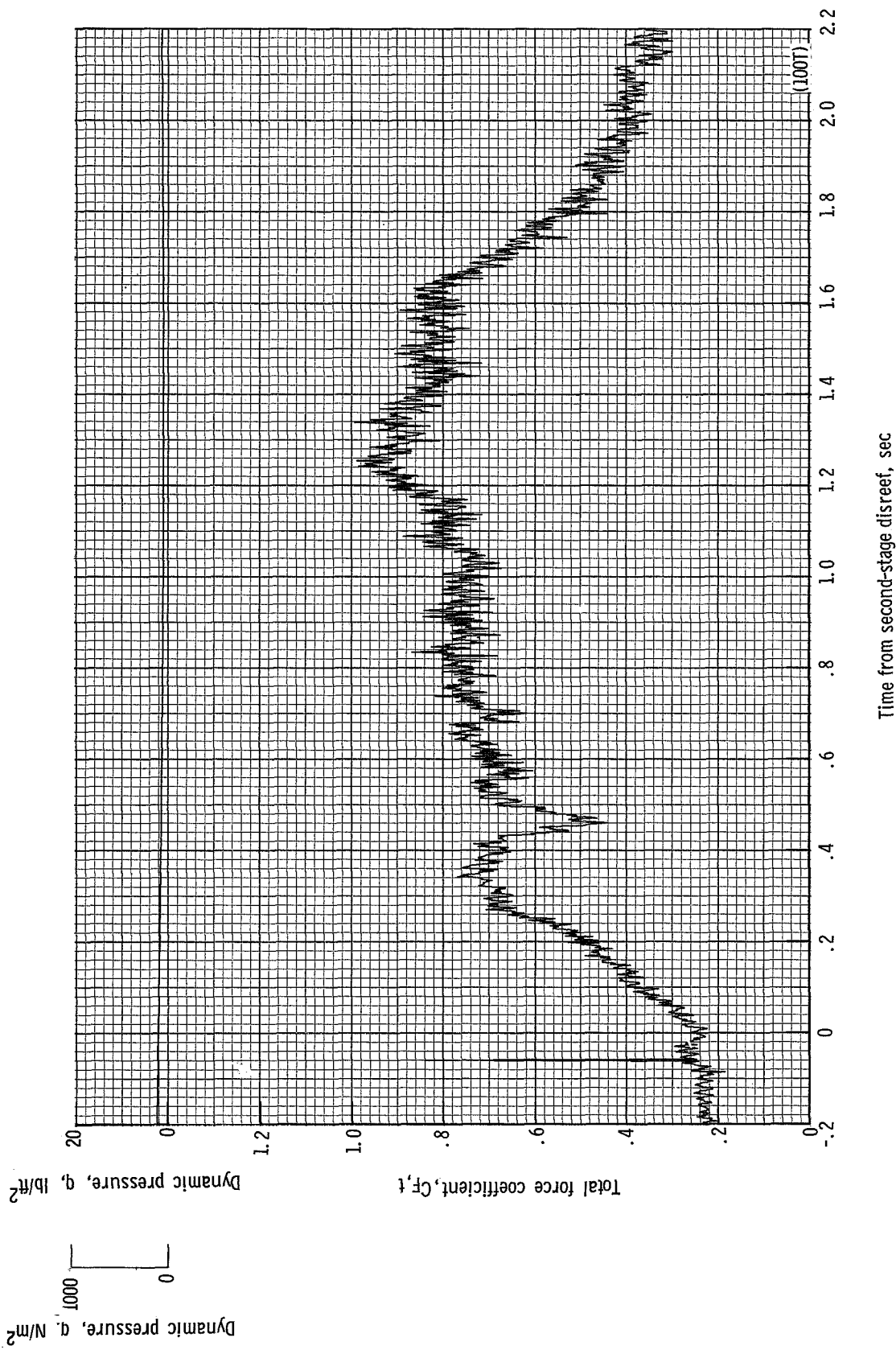
(m) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rr} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.61 seconds after launch.

Figure 22.- Continued.



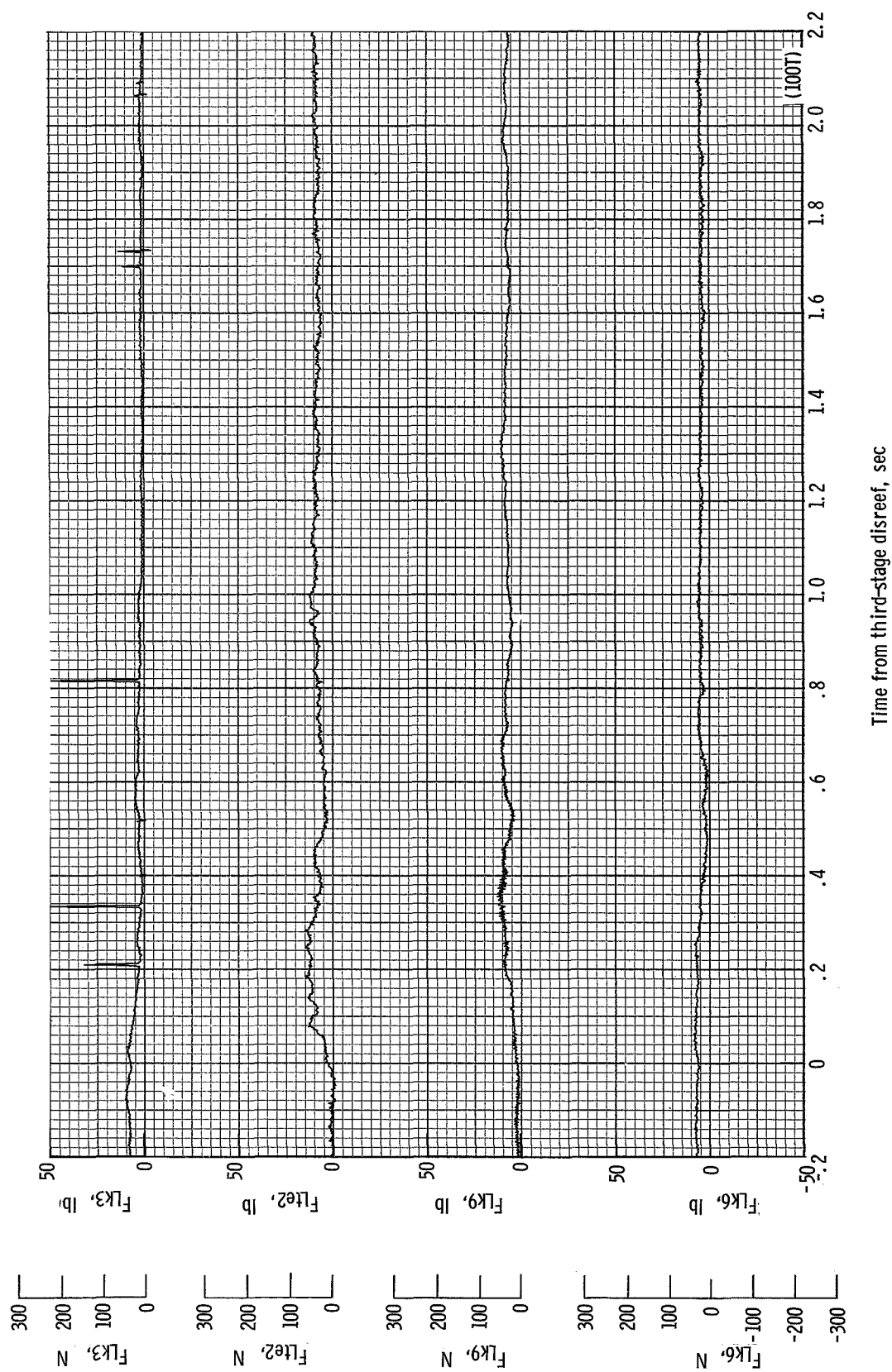
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 32.61 seconds after launch.

Figure 22.- Continued.



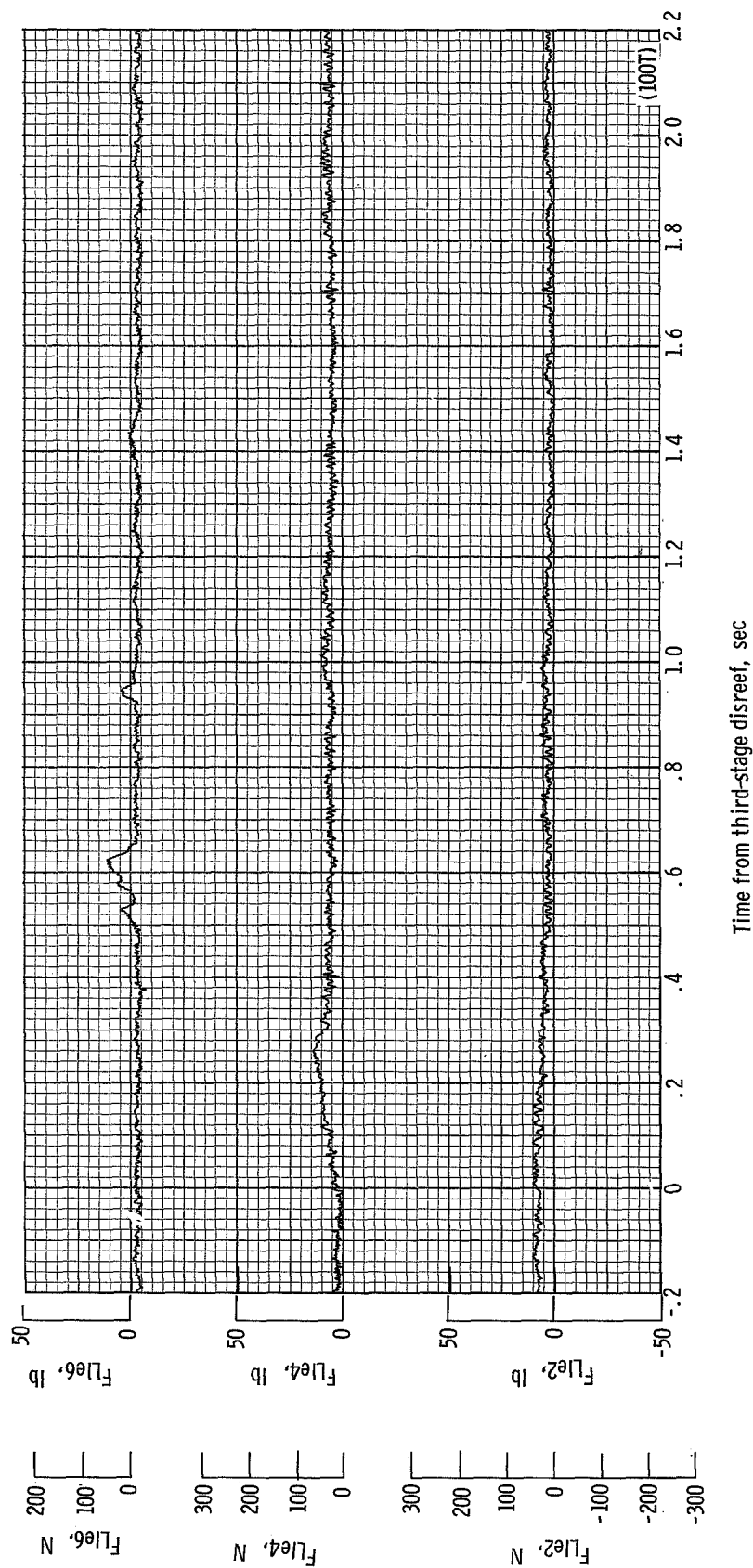
(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 32.61 seconds after launch.

Figure 22.- Continued.



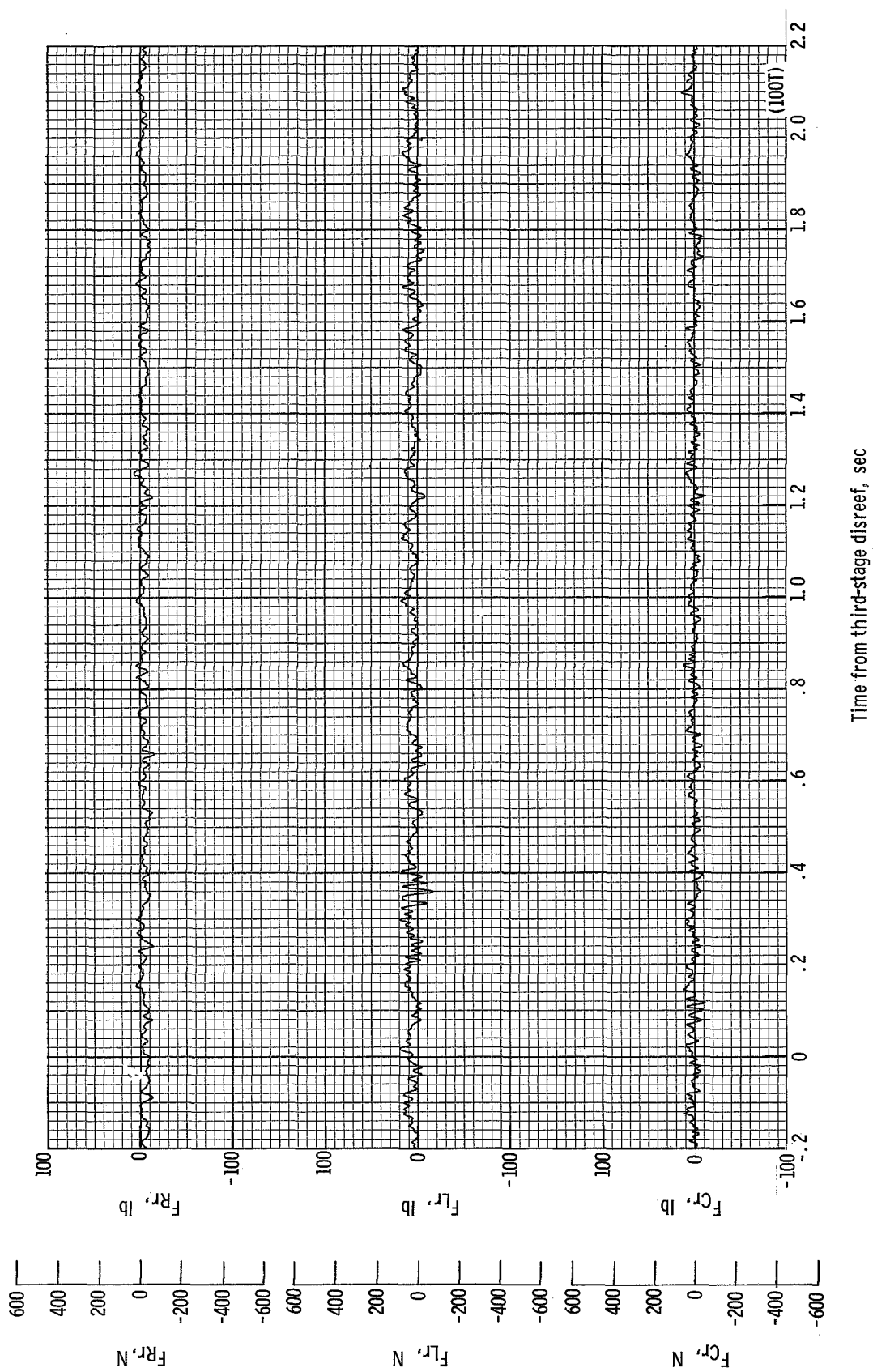
(p) Individual suspension-line loads F_{LK6} , F_{LK9} , F_{LTe2} , and F_{LK3} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.17 seconds after launch.

Figure 22.- Continued.



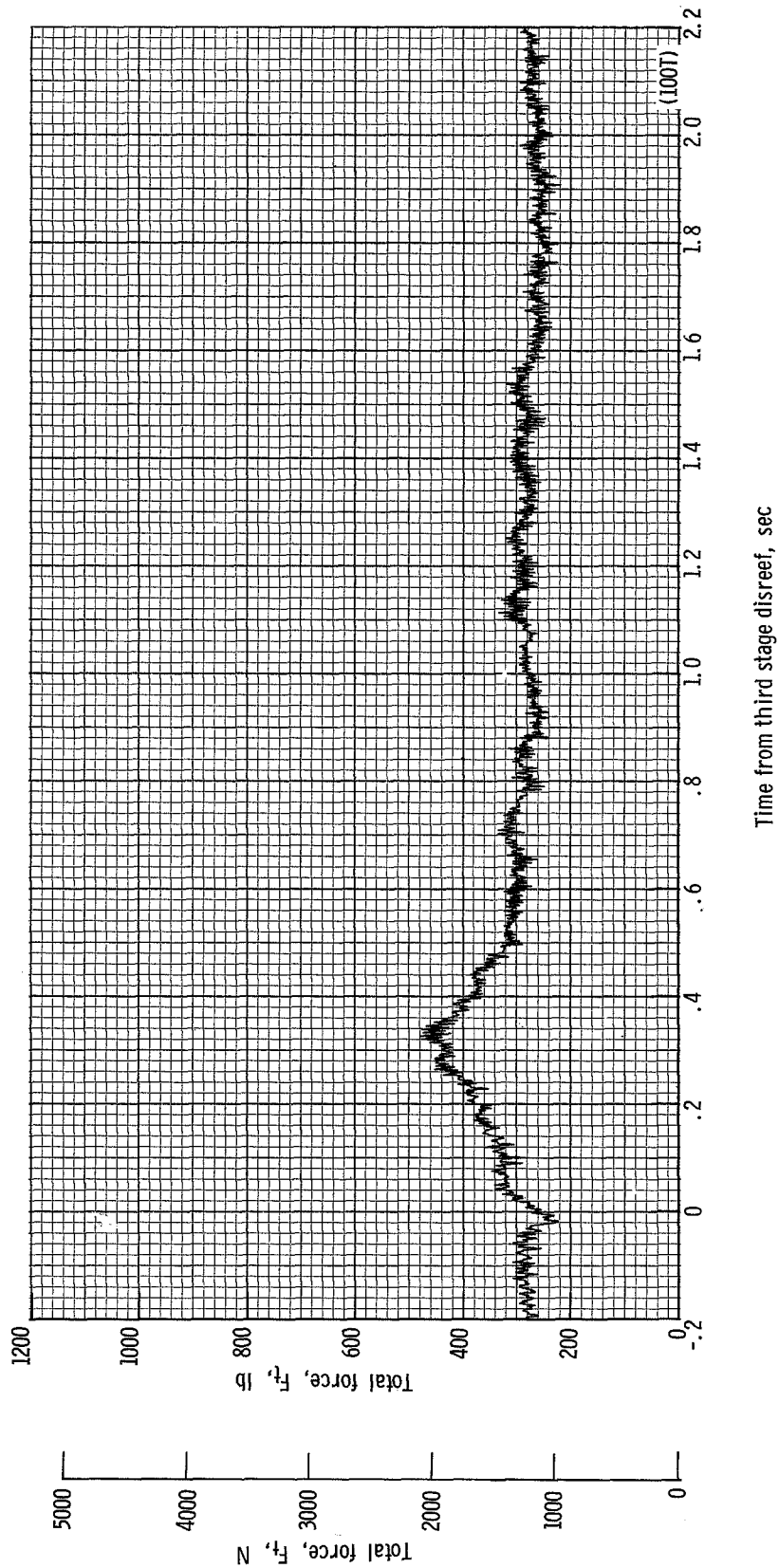
(q) Individual suspension-line loads F_{Lle2} , F_{Lle4} , and F_{Lle6} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.17 seconds after launch.

Figure 22.- Continued.



(r) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rr} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.17 seconds after launch.

Figure 22.- Continued.



(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.17 seconds after launch.

Figure 22. - Continued.

Dynamic pressure, q , N/m²

1000

0

Dynamic pressure, q , lb/ft²

20

0

9

8

7

6

5

4

3

Total force coefficient, $C_{F,t}$

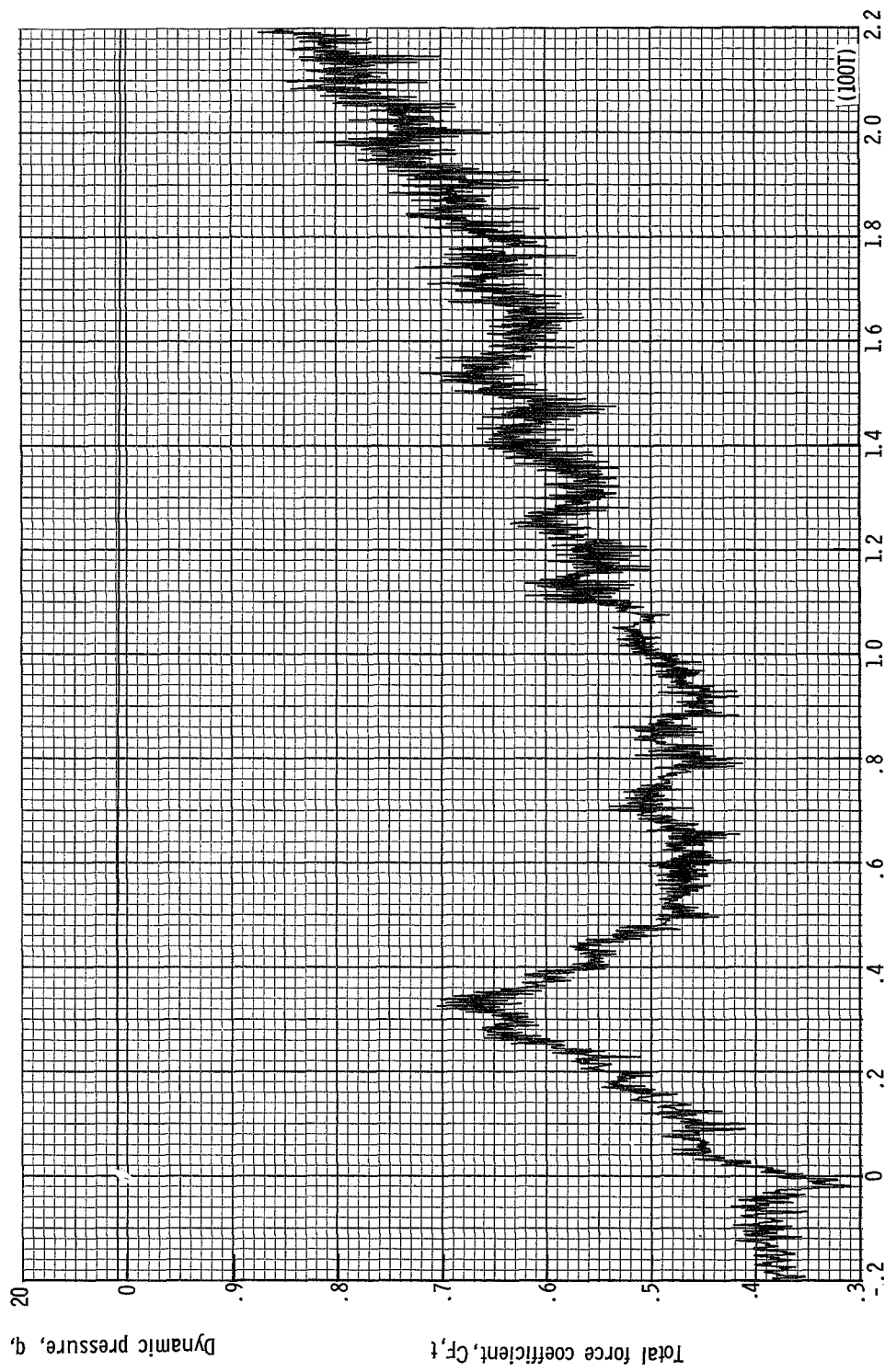
7

6

5

4

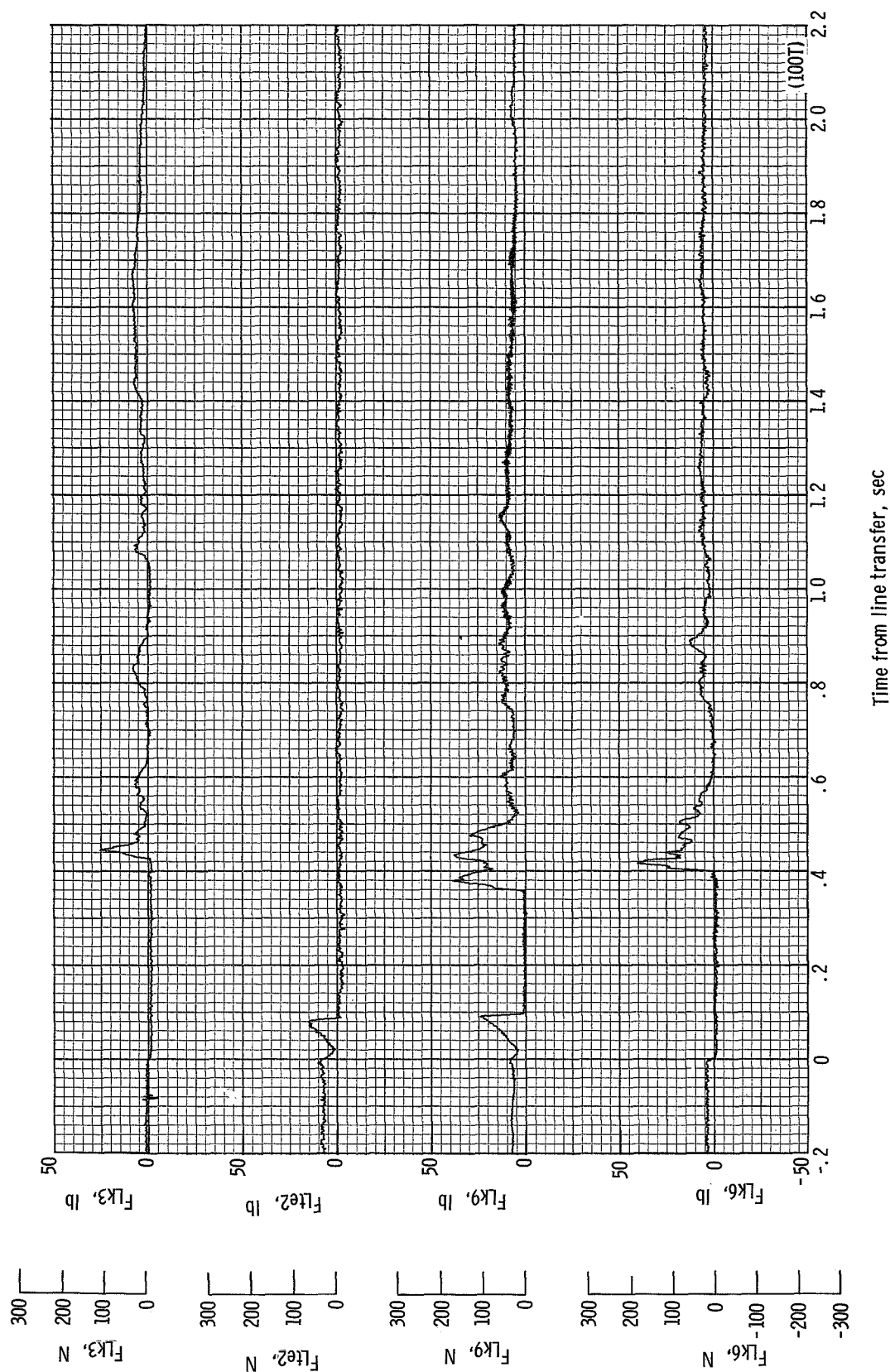
3



Time from third-stage disreef, sec

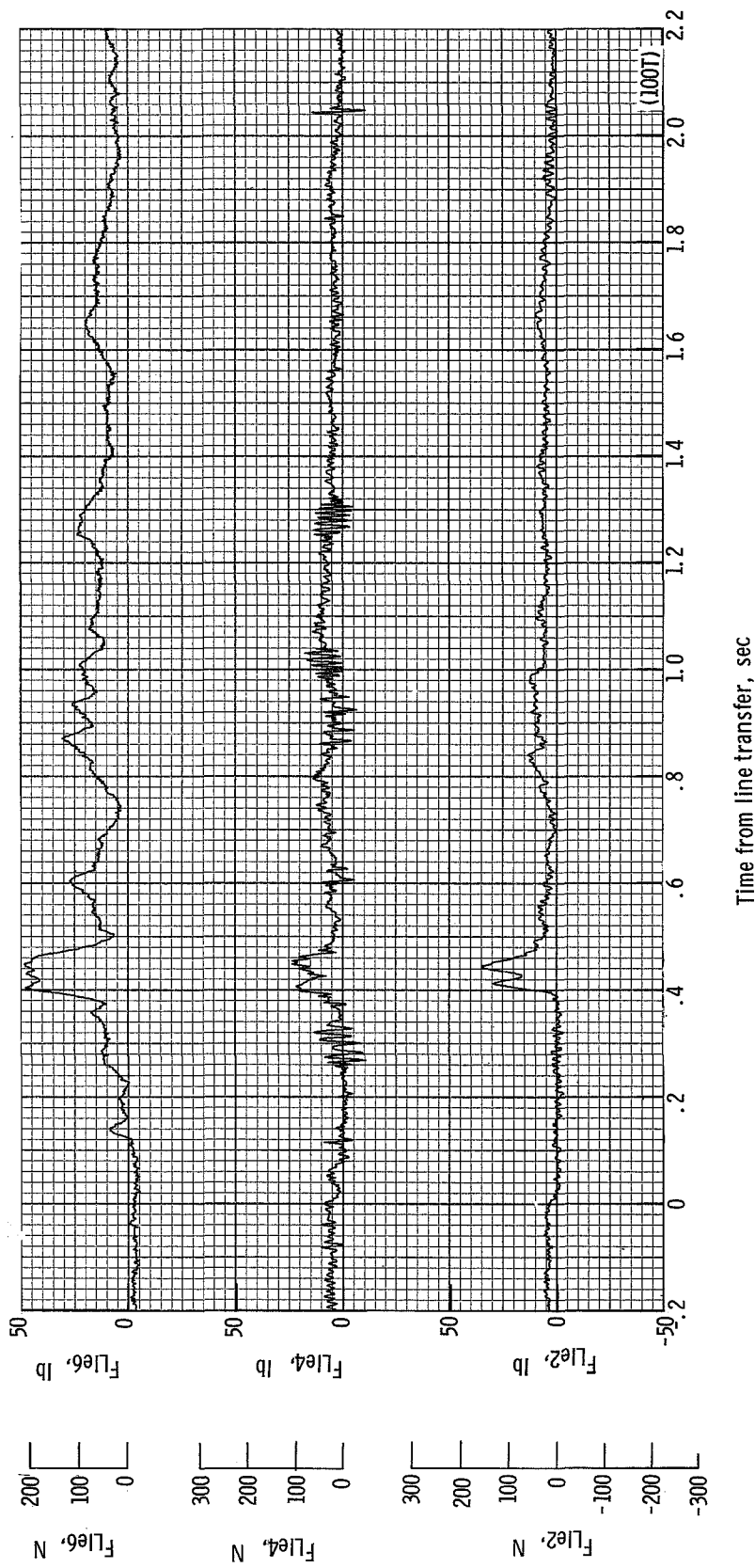
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.17 seconds after launch.

Figure 22. - Continued.



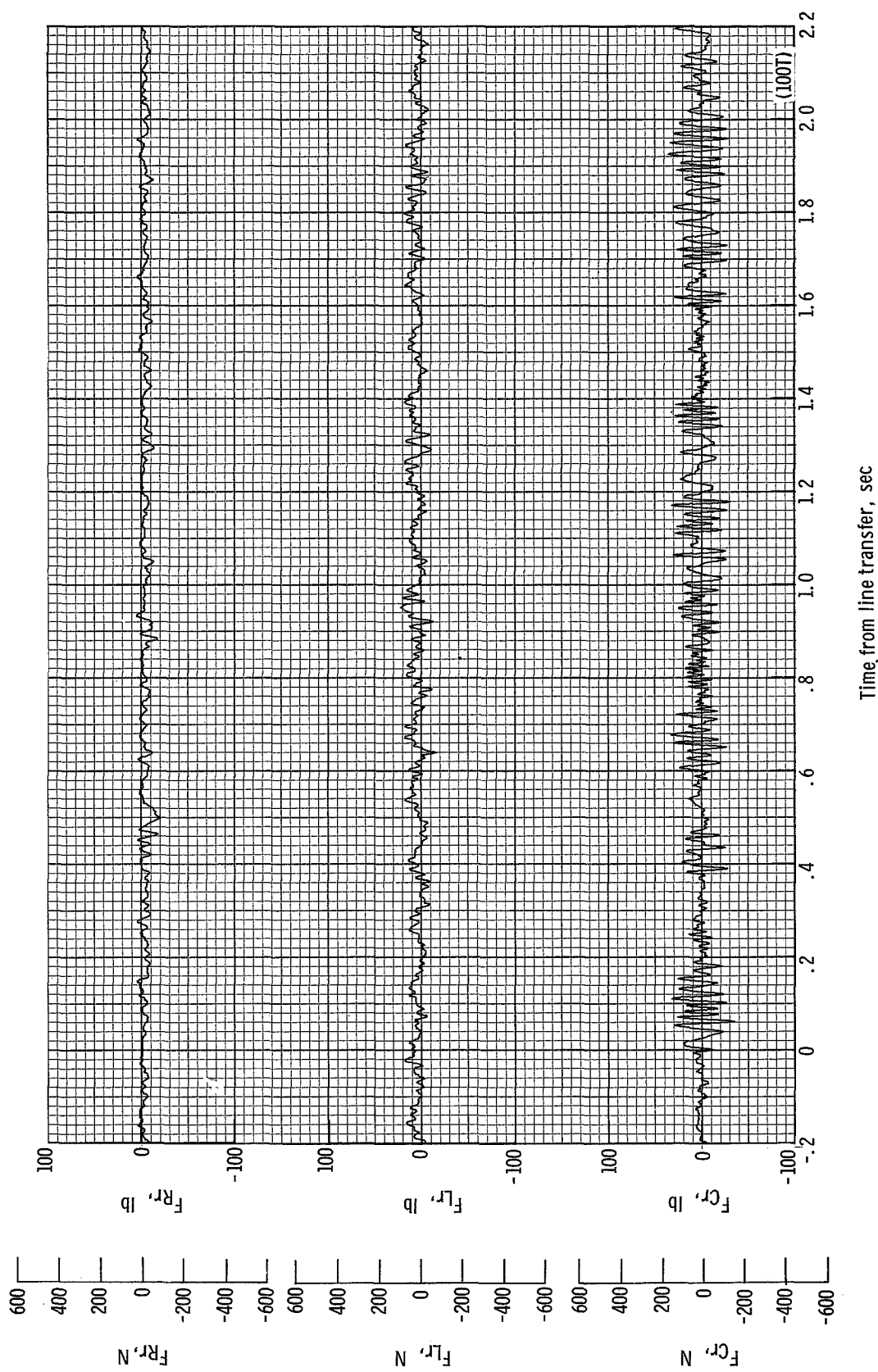
(u) Individual suspension-line loads F_{Lk6} , F_{Lk9} , F_{Lte2} , and F_{Lk3} plotted against time from line transfer. Time = 0 second corresponds to 39.13 seconds after launch.

Figure 22. - Continued.



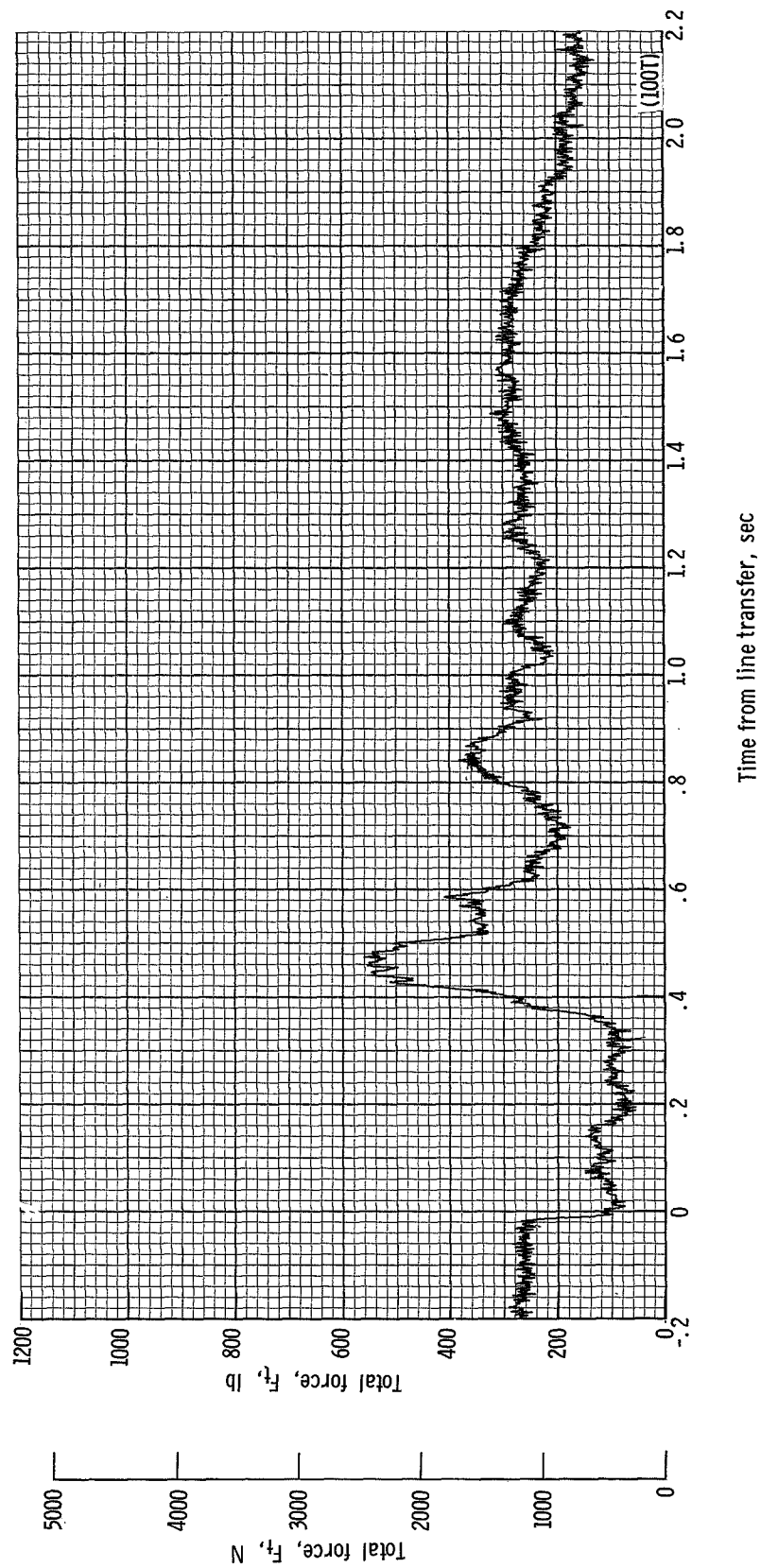
(v) Individual suspension-line loads F_{Lie2} , F_{Lie4} and F_{Lie6} plotted against time from line transfer. Time = 0 second corresponds to 39.13 seconds after launch.

Figure 22.- Continued.



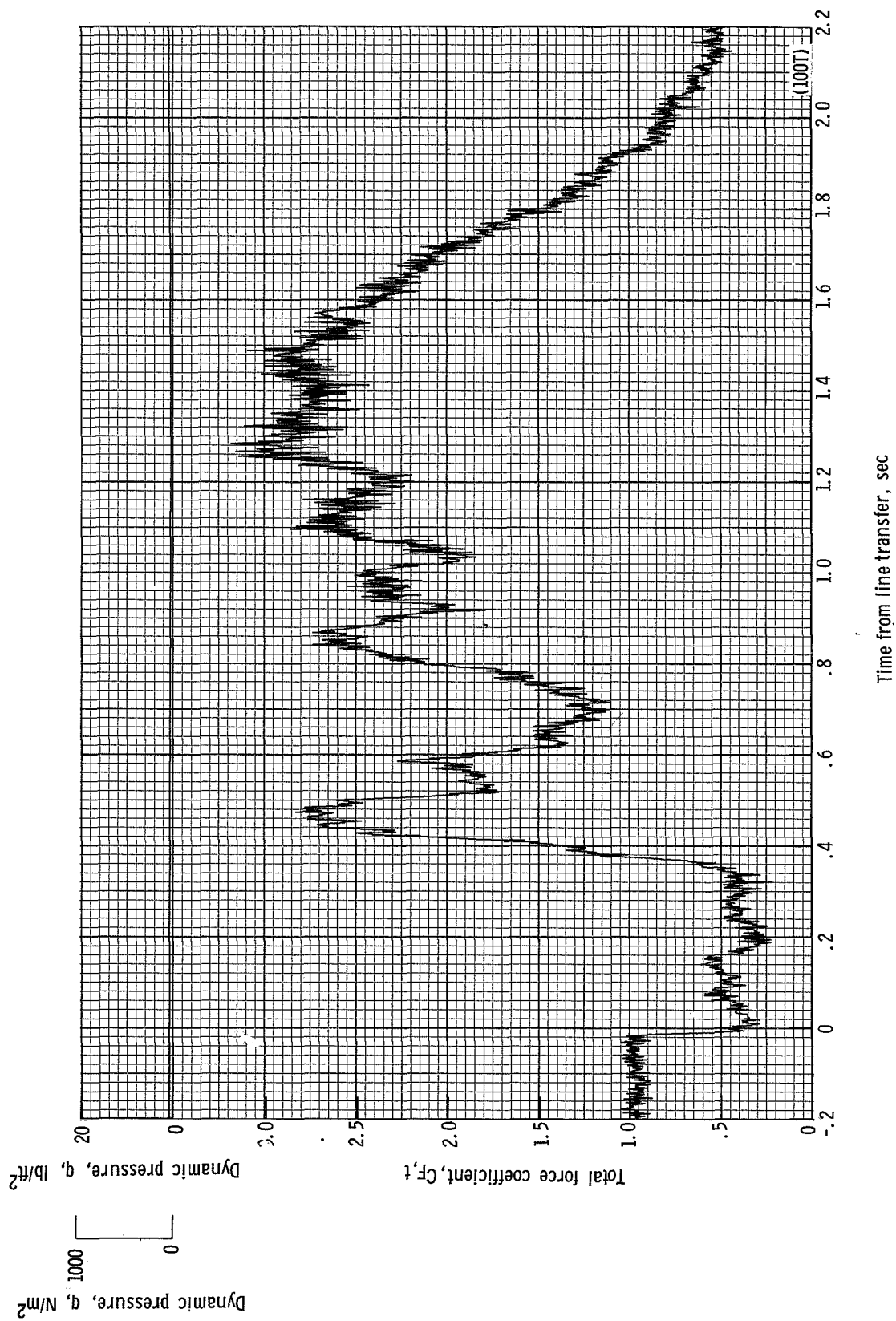
(w) Individual reefing-line loads F_{CR} , F_{LR} , and F_{RT} plotted against time from line transfer. Time = 0 second corresponds to 39.13 seconds after launch.

Figure 22.- Continued.



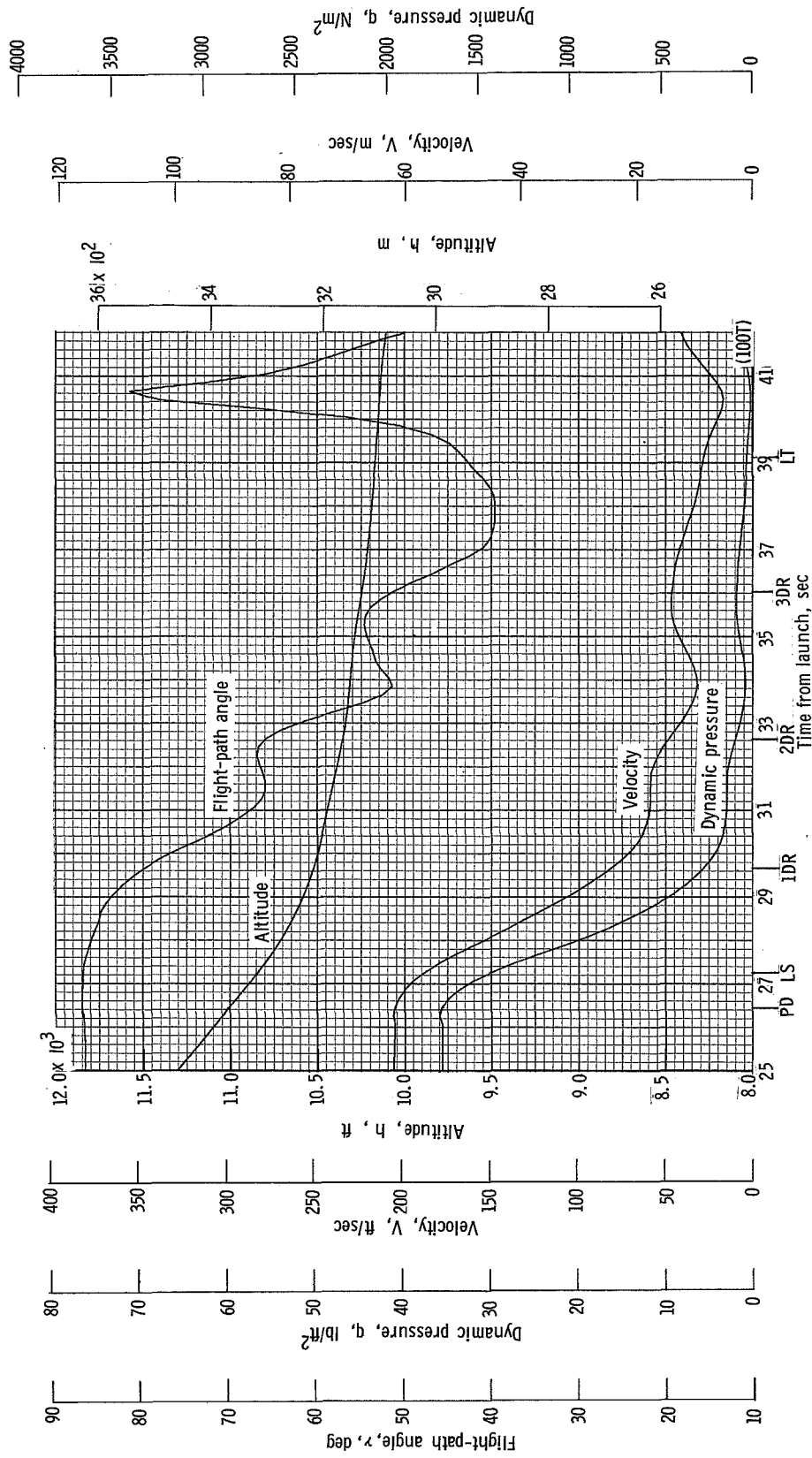
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 39.13 seconds after launch.

Figure 22.- Continued.



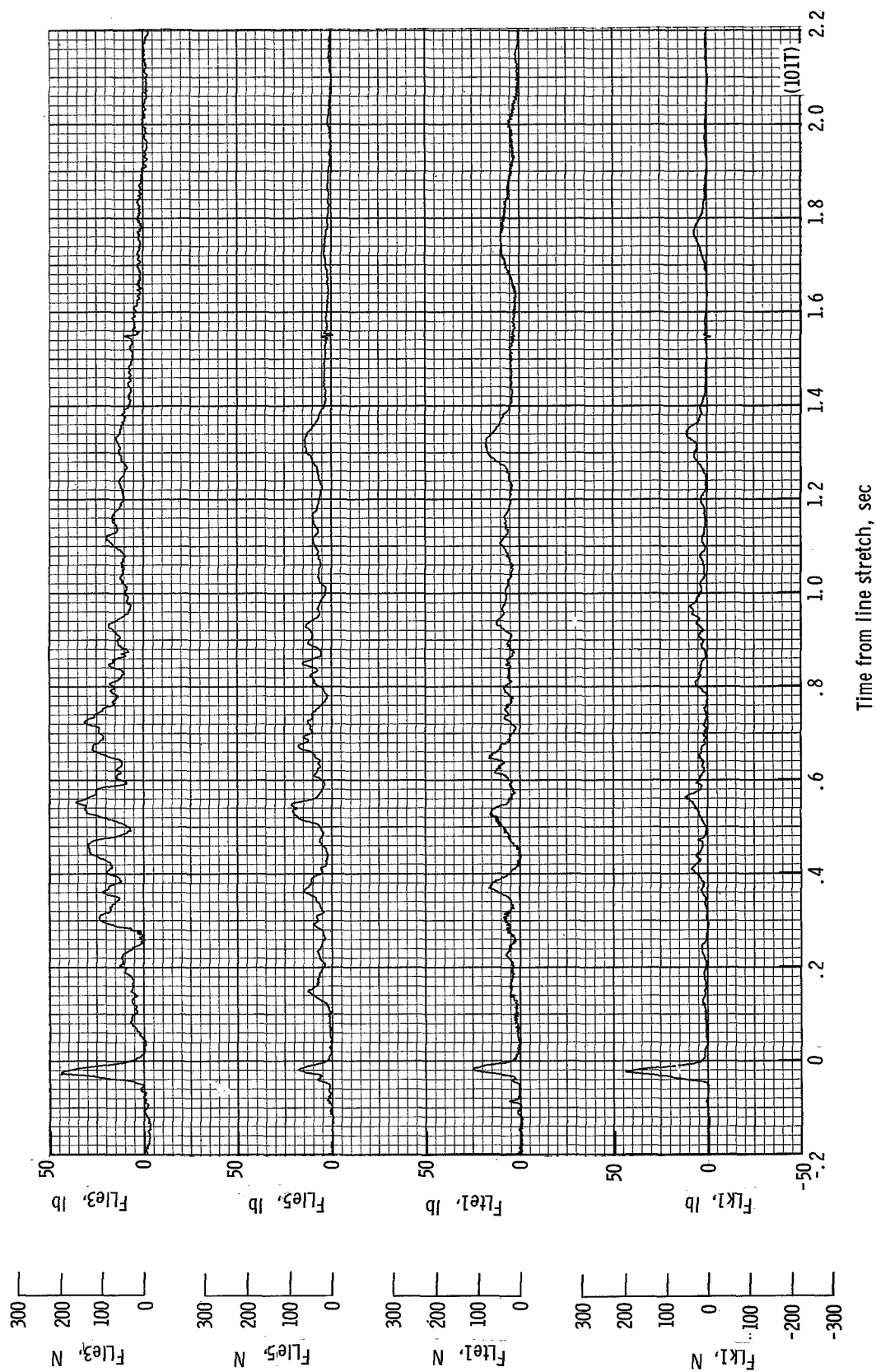
(y) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 39.13 seconds after launch.

Figure 22.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 22. - Concluded.

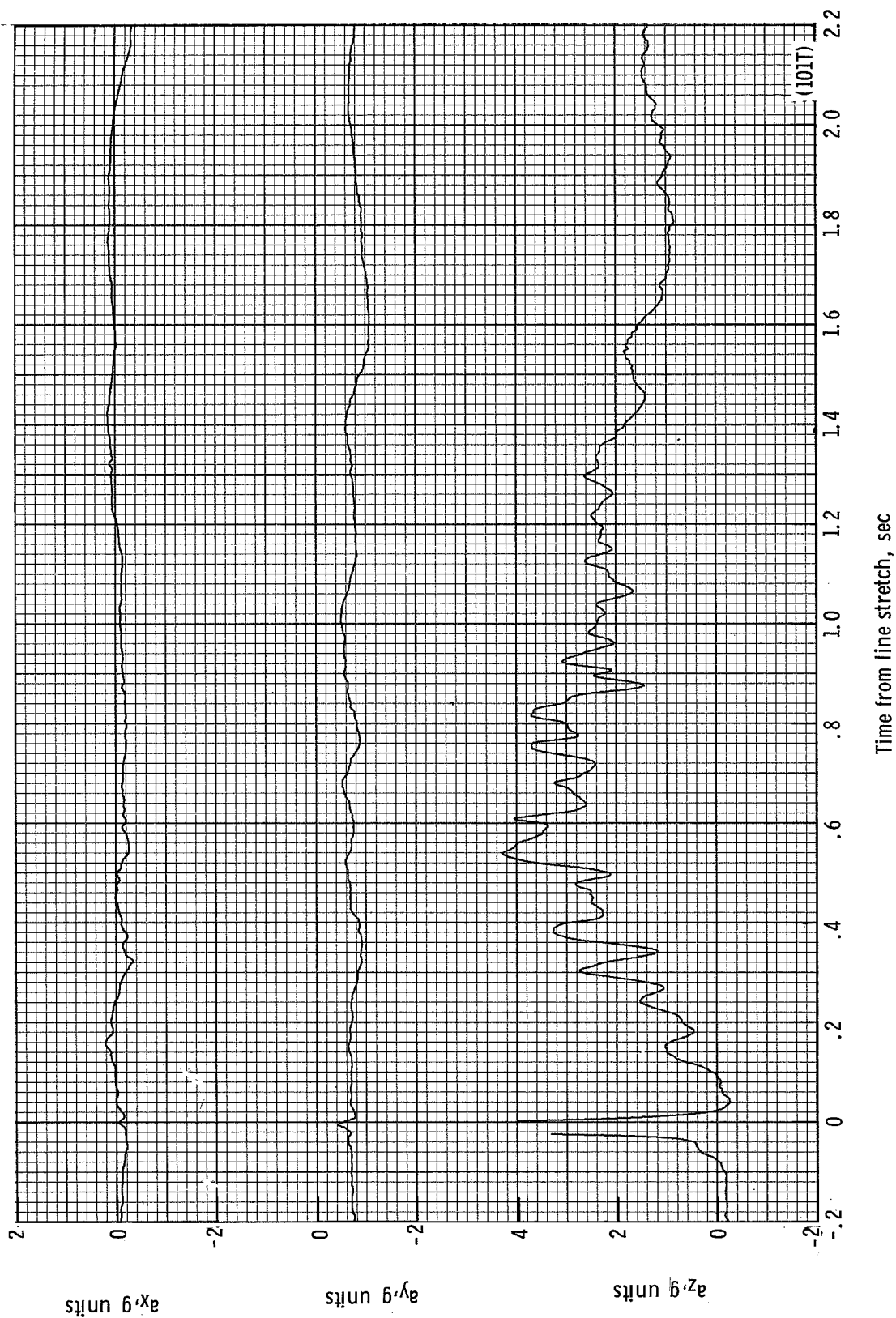


(a) Individual suspension-line loads F_{Lk1} , F_{Lte1} , F_{Lle5} , and F_{Lle3} plotted against time from line stretch. Time = 0 second corresponds to 26.86 seconds after launch.

Figure 23.- Time history of twin-keel parawing deployment data for test 101T. $W_D = 953.7 \text{ N}$ (214.4 lb); $W_P = 798.7 \text{ N}$ (179.6 lb); $q_{PD} = 1747.6 \text{ N/m}^2$ (36.5 lb/ft²); $h_{PD} = 4037 \text{ m}$ (13 245 ft); $z_r/l_k = 0.156$; reefing version 1.

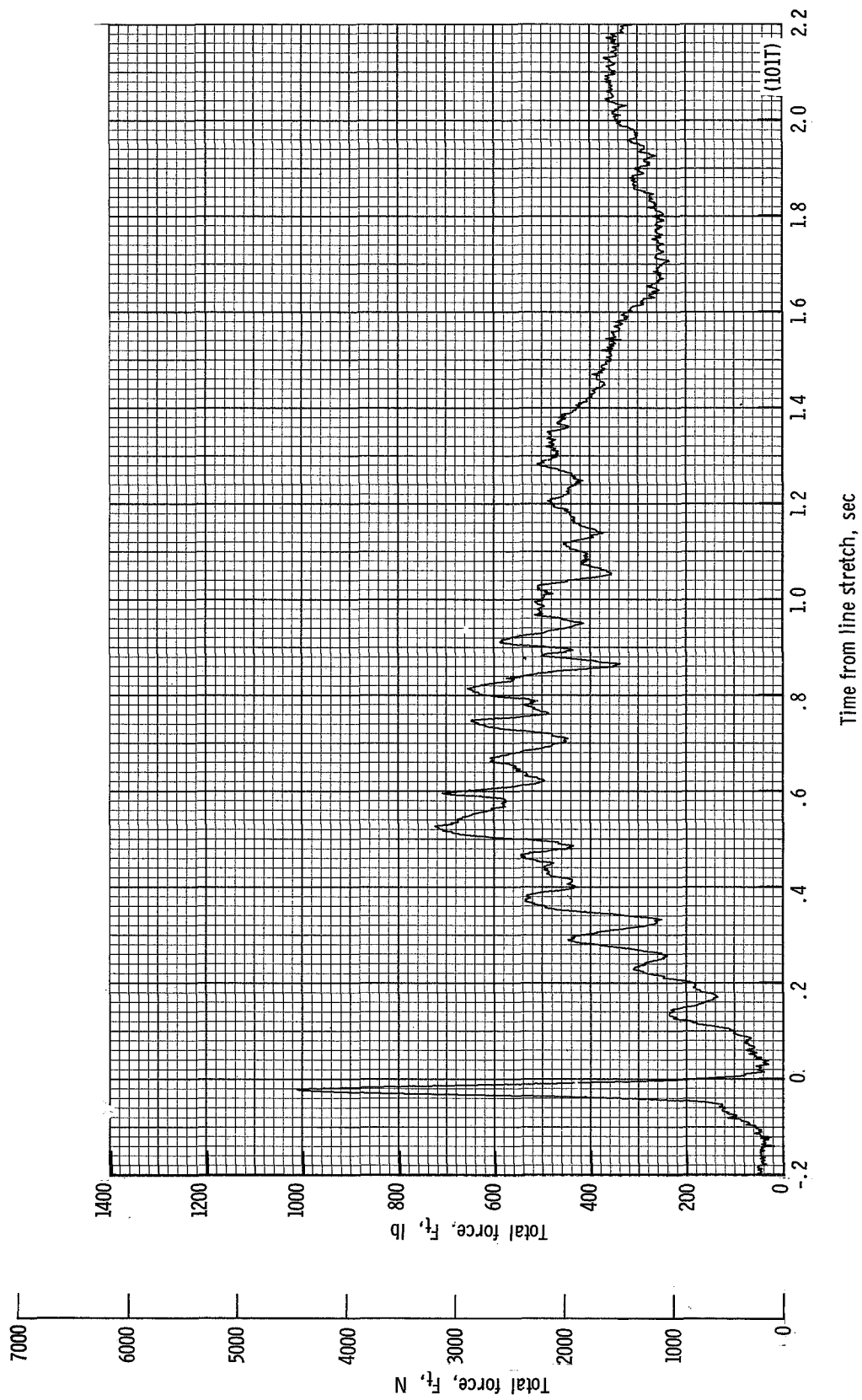
(b) Individual suspension-line loads F_{L1e} , F_{Lk12} , and F_{L16} plotted against time from line stretch. Time = 0 second corresponds to 26.86 seconds after launch.

Figure 23.- Continued.



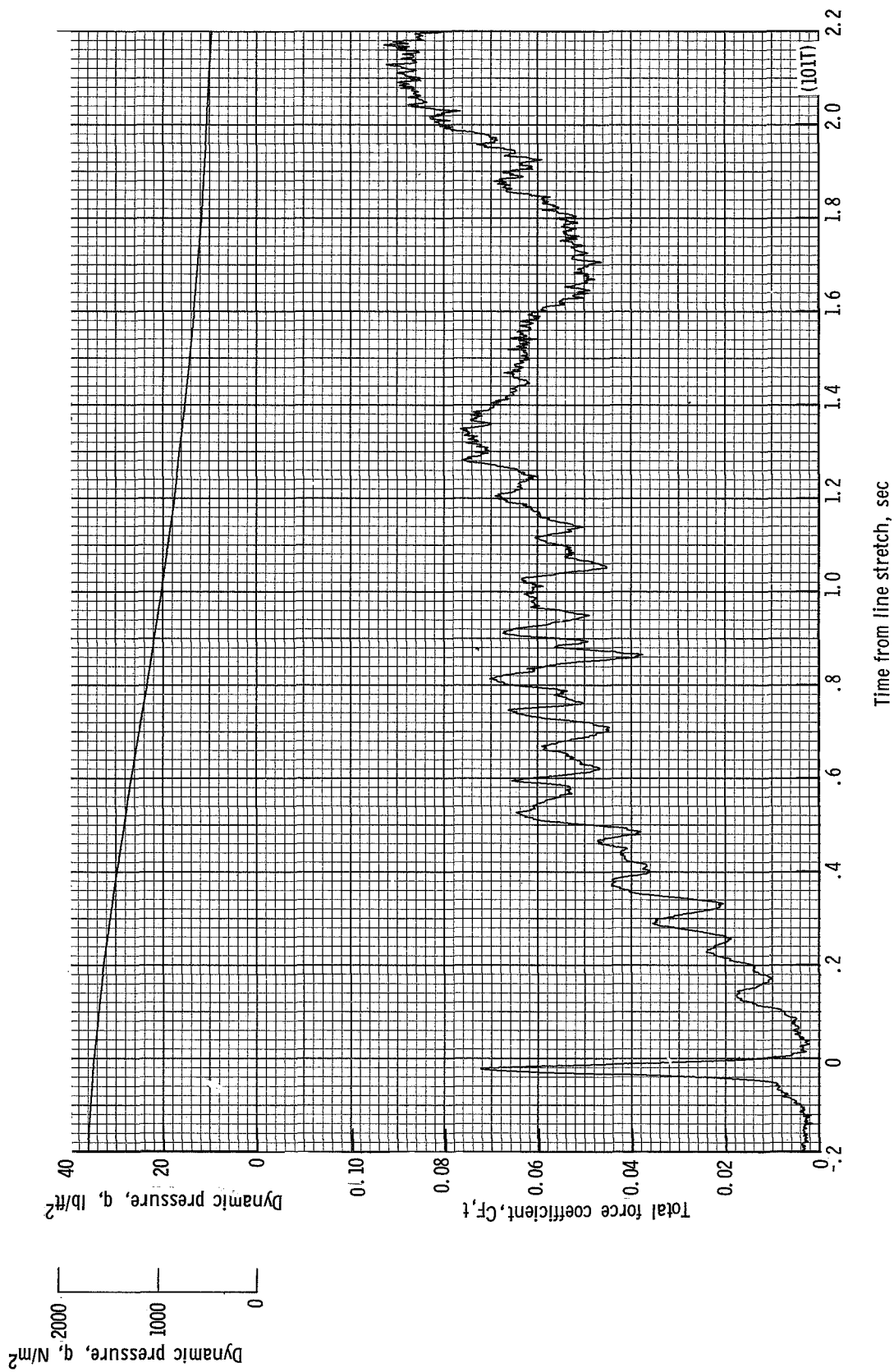
(c) Accelerations a_z , a_y , and a_x plotted against time from line stretch. Time = 0 second corresponds to 26.86 seconds after launch.

Figure 23.- Continued.



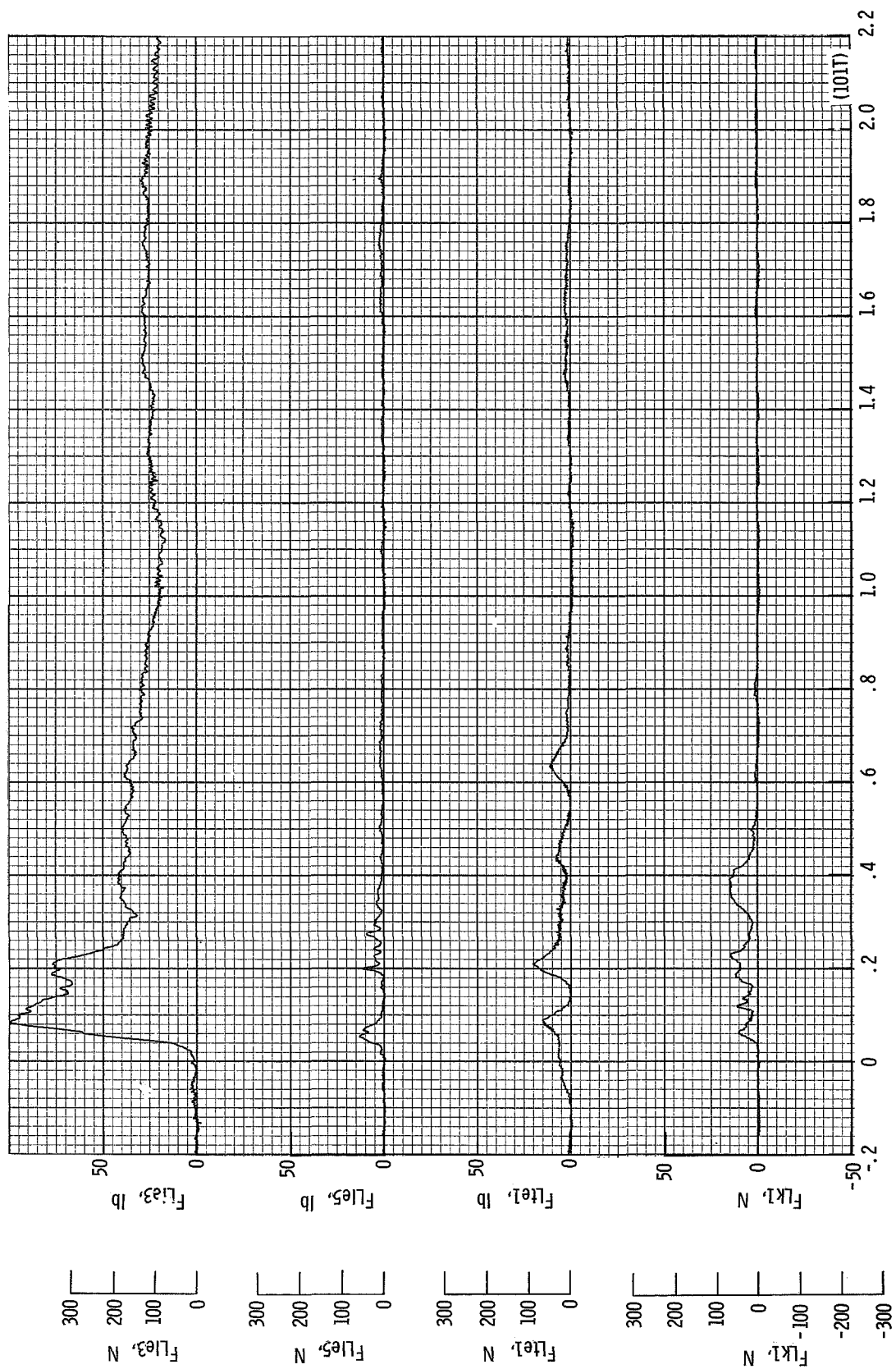
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 26.86 seconds after launch.

Figure 23.- Continued.



(e) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 26.86 seconds after launch.

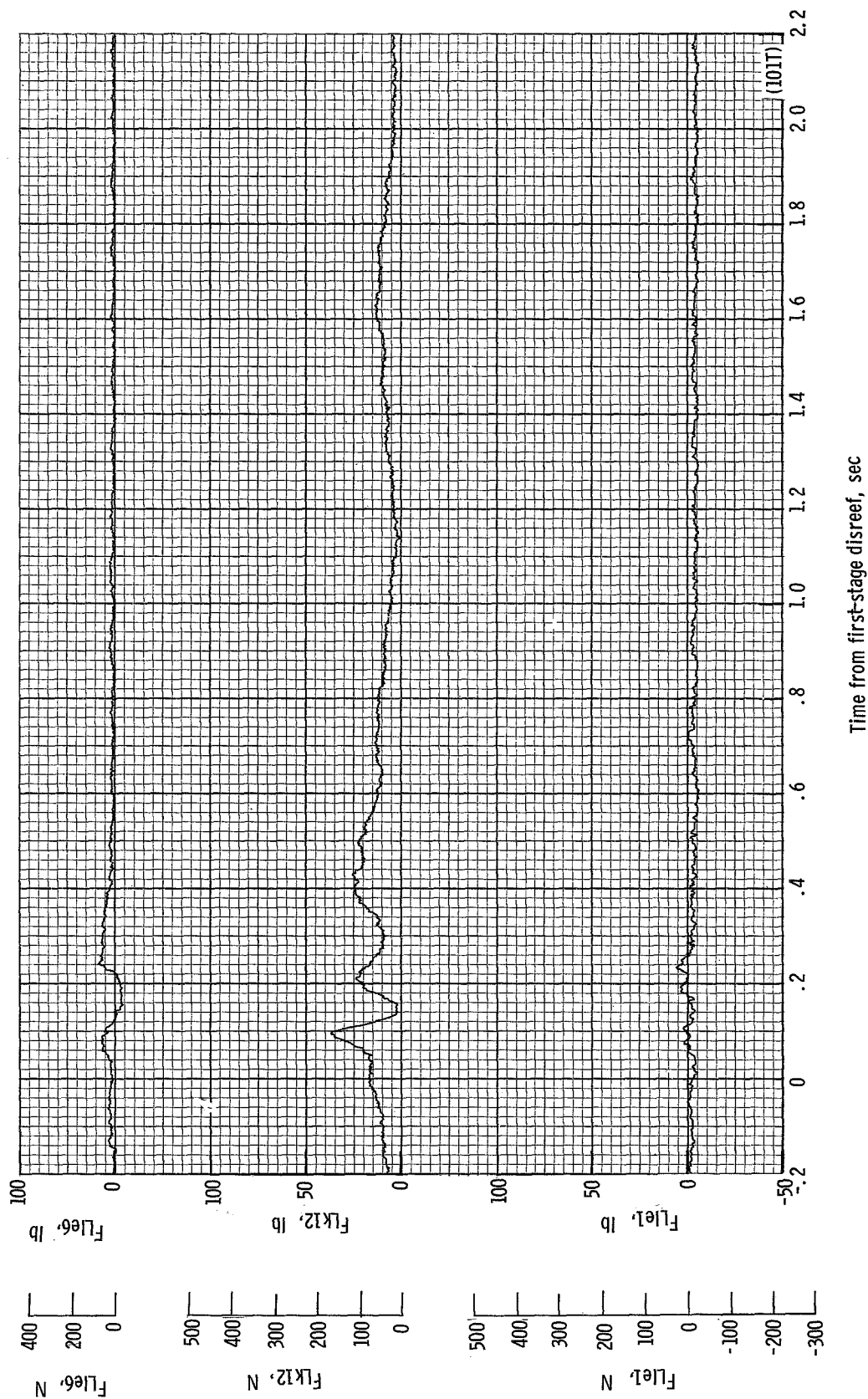
Figure 23.- Continued.



Time from first-stage disreef, sec

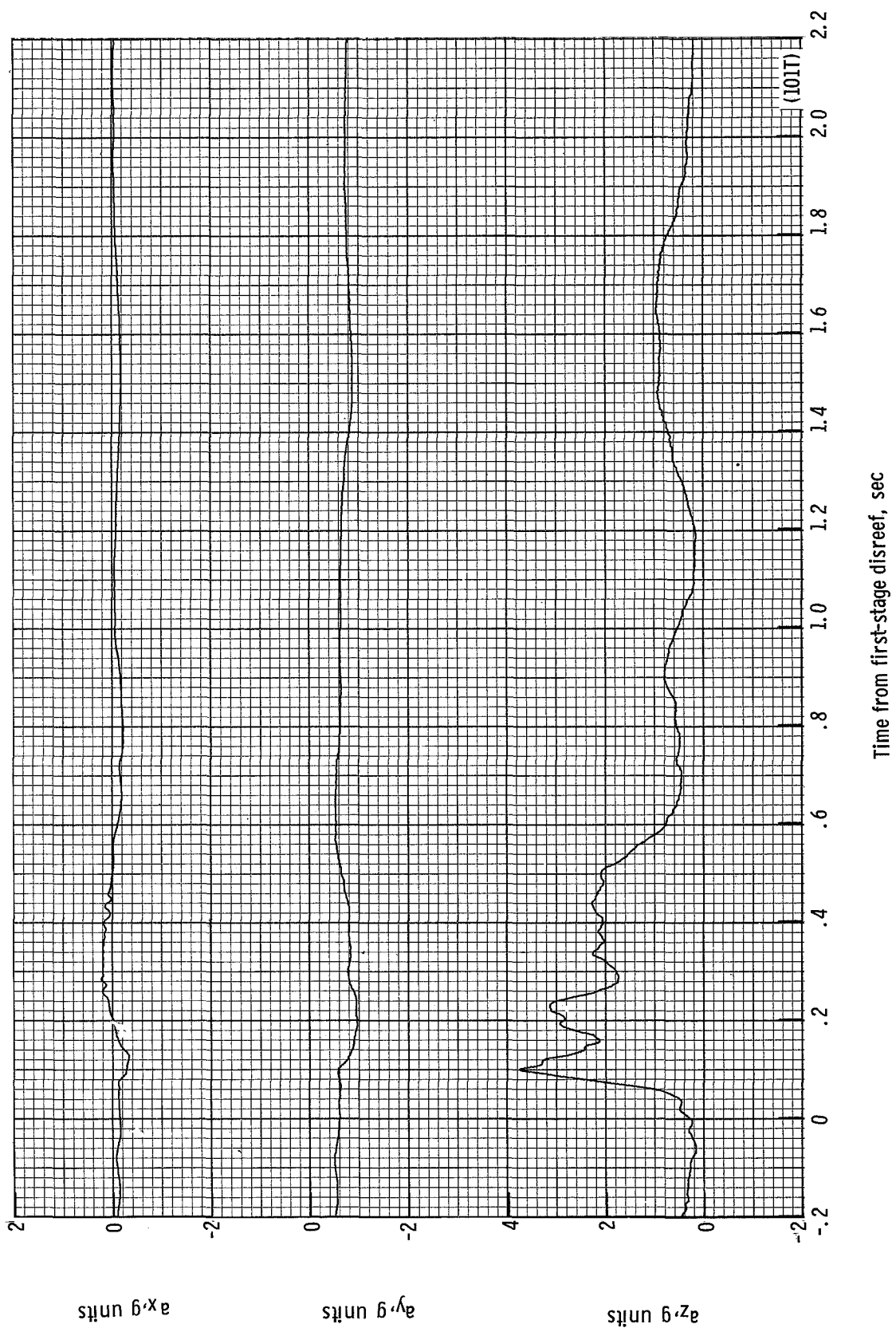
(f) Individual suspension-line loads $FLK1$, $FLie1$, $FLie5$, and $FLie3$ plotted against time from first-stage disreef. Time = 0 second corresponds to 29.61 seconds after launch.

Figure 23.- Continued.



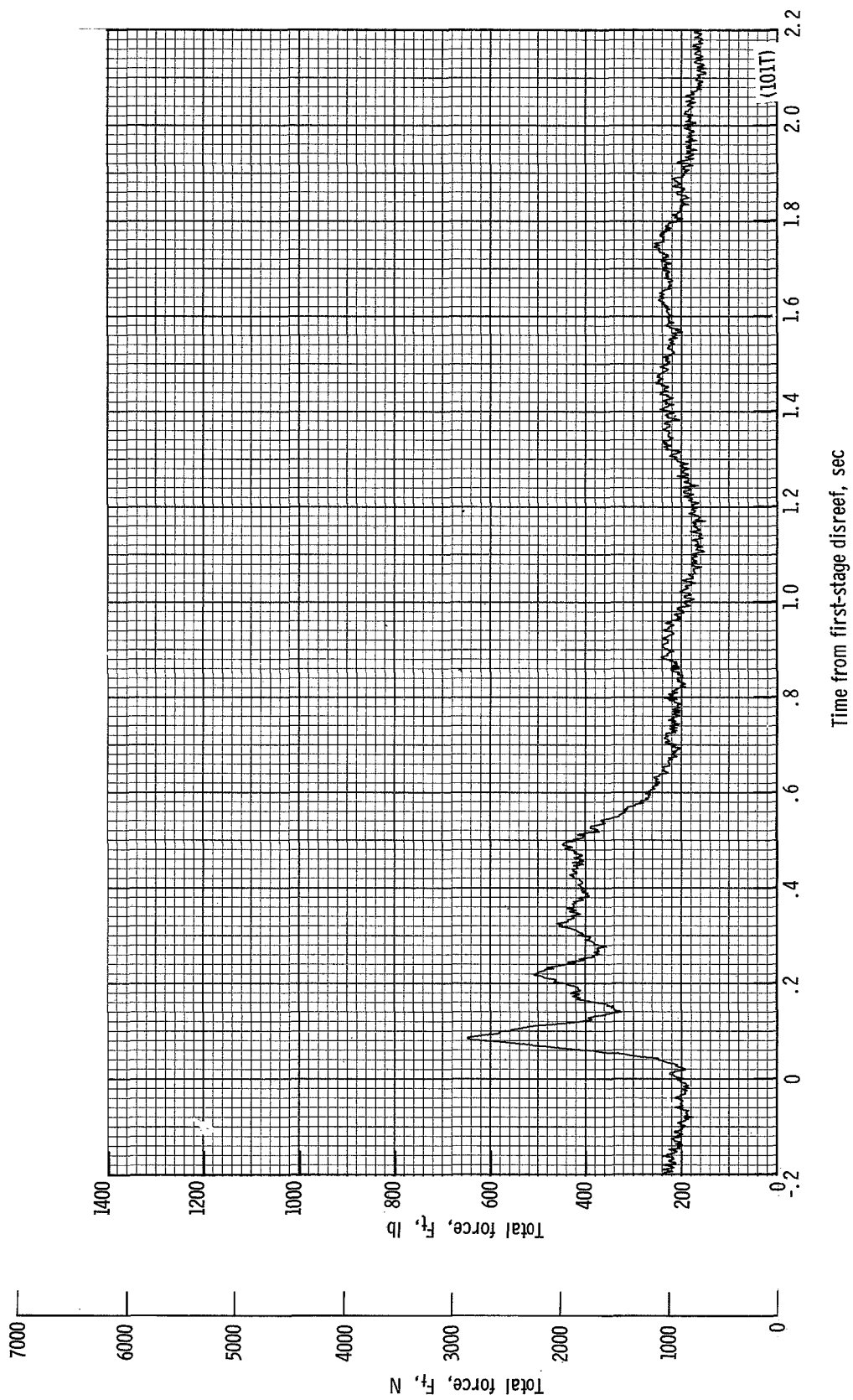
(g) Individual suspension-line loads F_{Lle1} , F_{LK12} , and F_{Lle6} plotted against time from first-stage disreef. Time = 0 second corresponds to 29.61 seconds after launch.

Figure 23.- Continued.



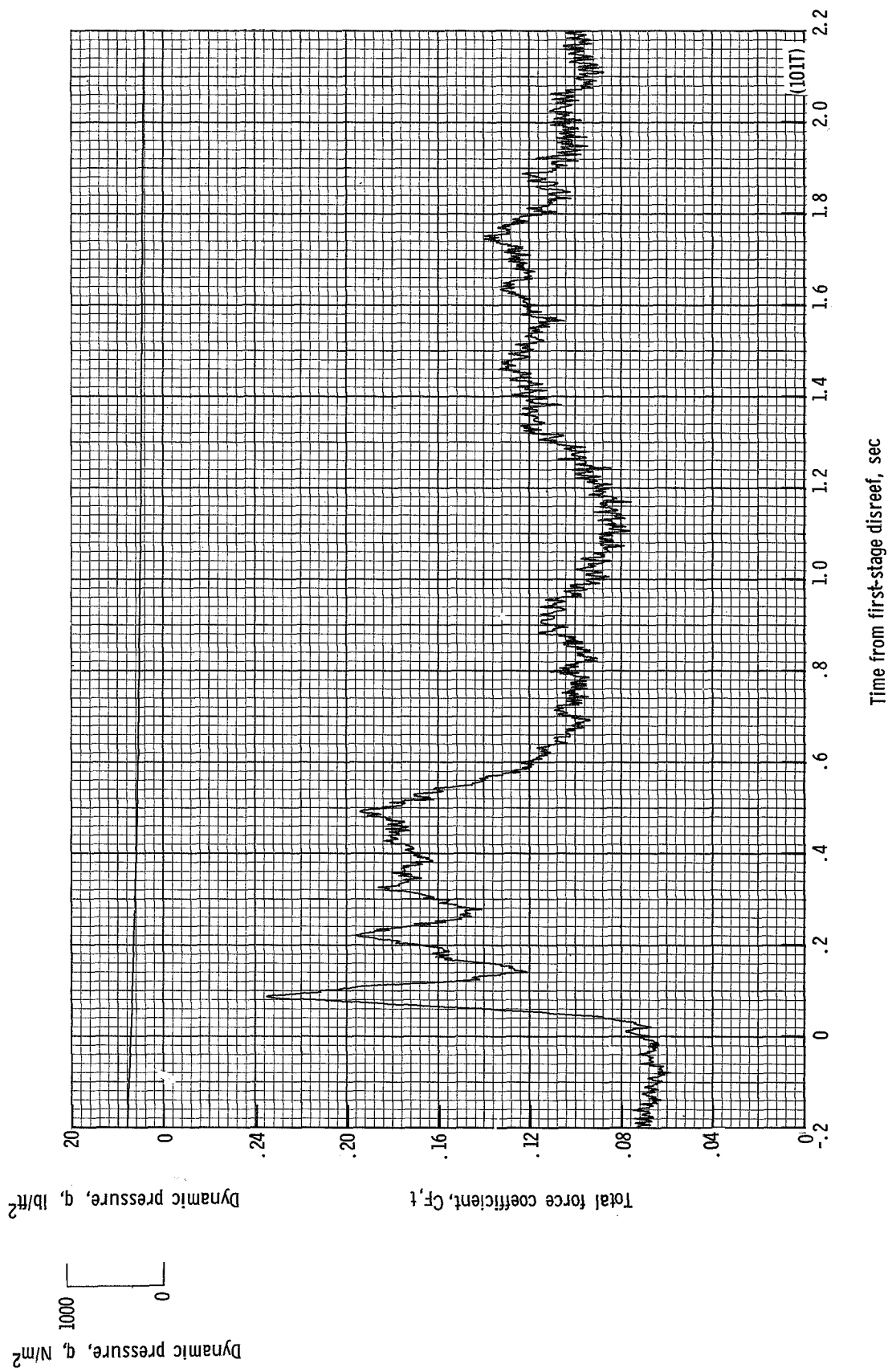
(h) Accelerations a_z , a_y , and a_x plotted against time from first-stage disreef. Time = 0 second corresponds to 29.61 seconds after launch.

Figure 23.- Continued.



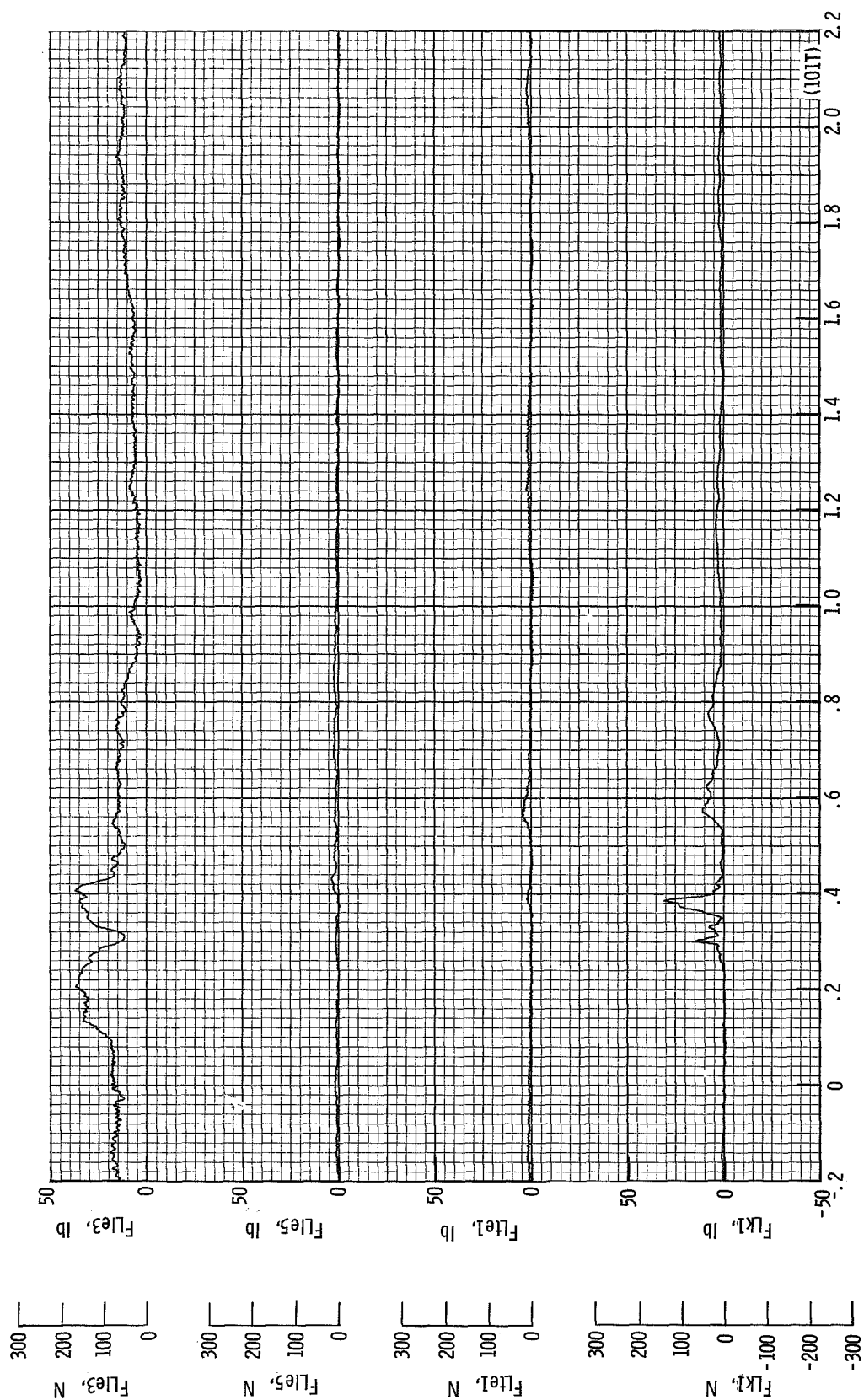
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 29.61 seconds after launch.

Figure 23.- Continued.



(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 29.61 seconds after launch.

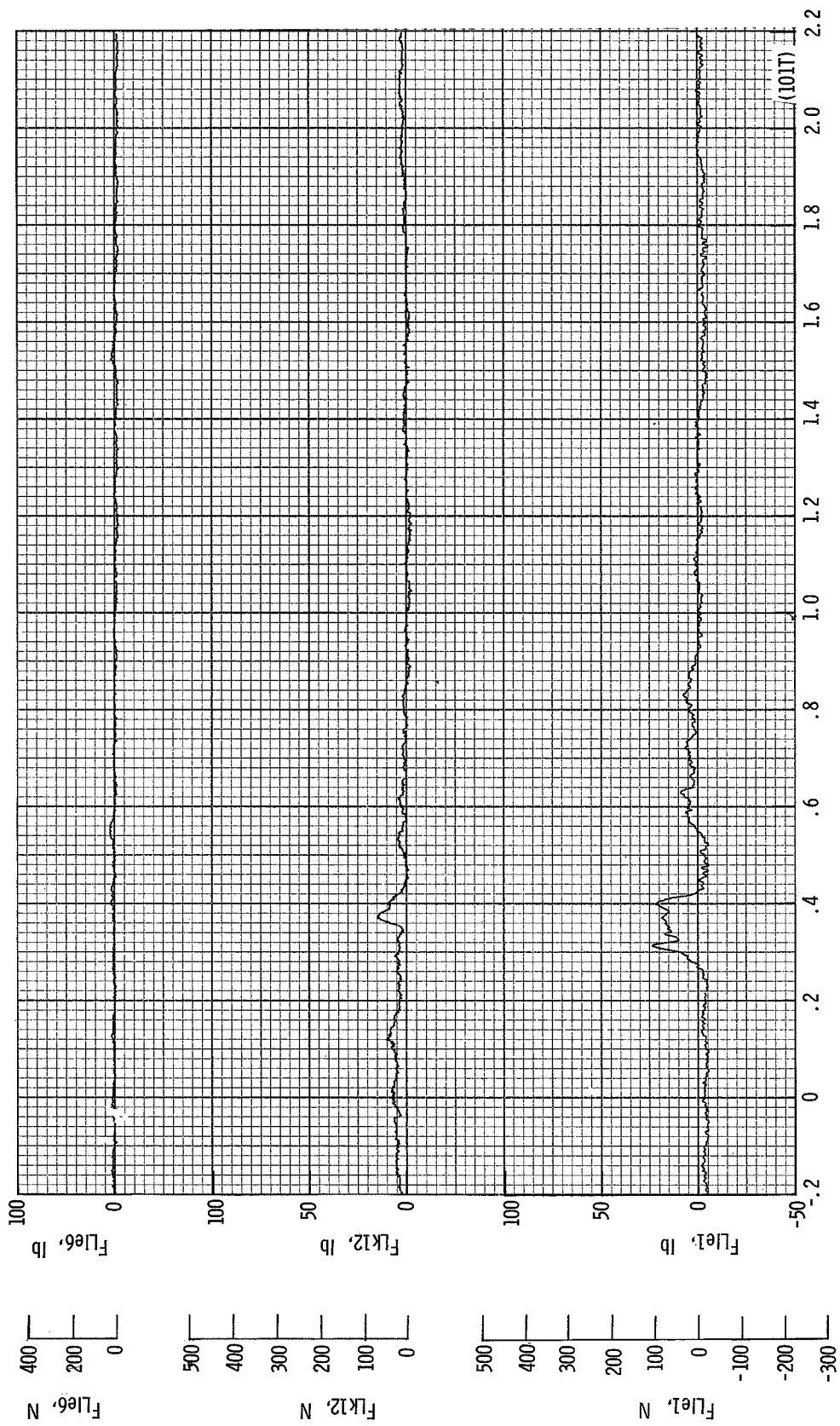
Figure 23.- Continued.



Time from second-stage disreef, sec

(k) Individual suspension-line loads F_{LK1} , F_{Lte1} , F_{Lle5} , and F_{Lle3} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.34 seconds after launch.

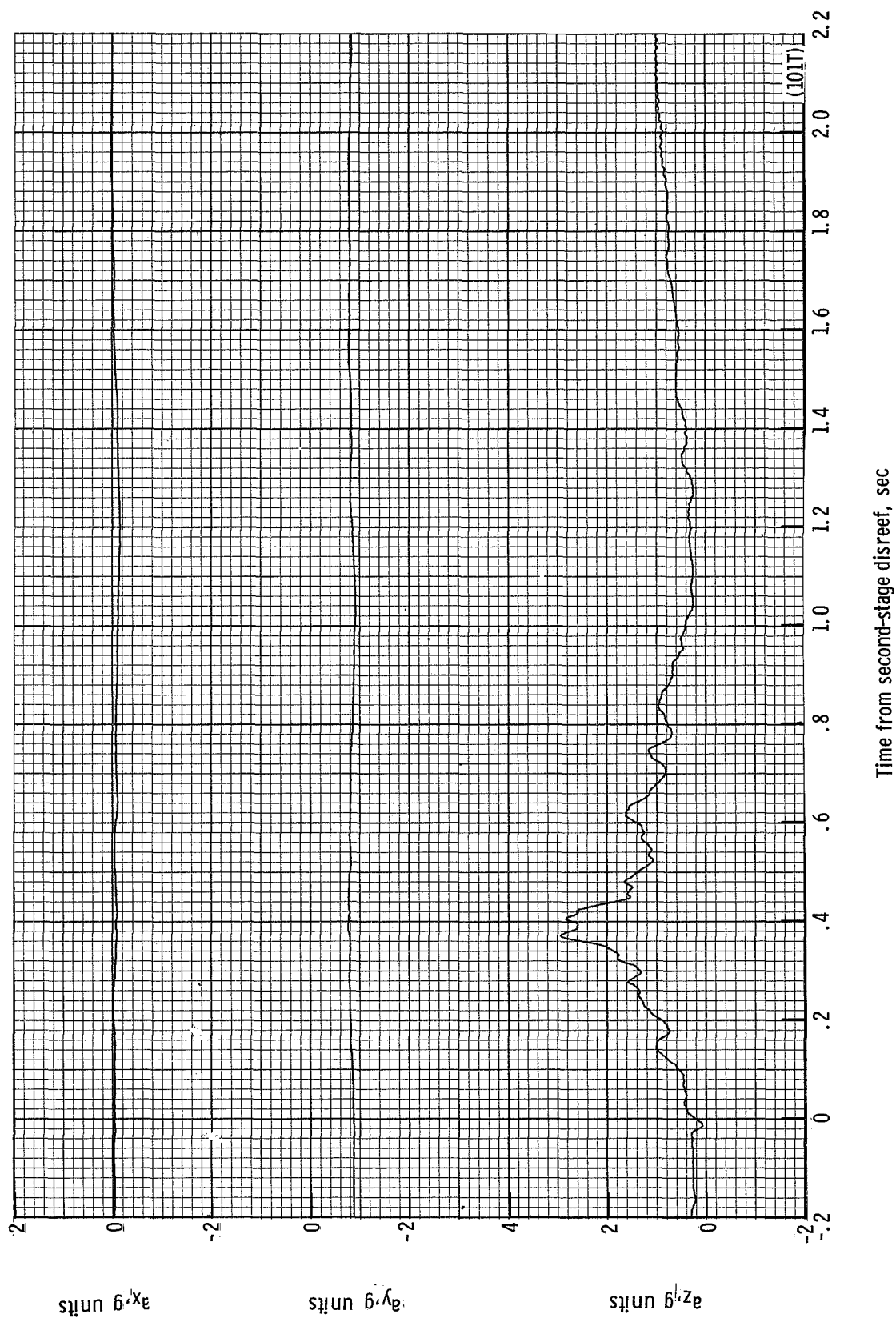
Figure 23.- Continued.



Time from second-stage disreef, sec

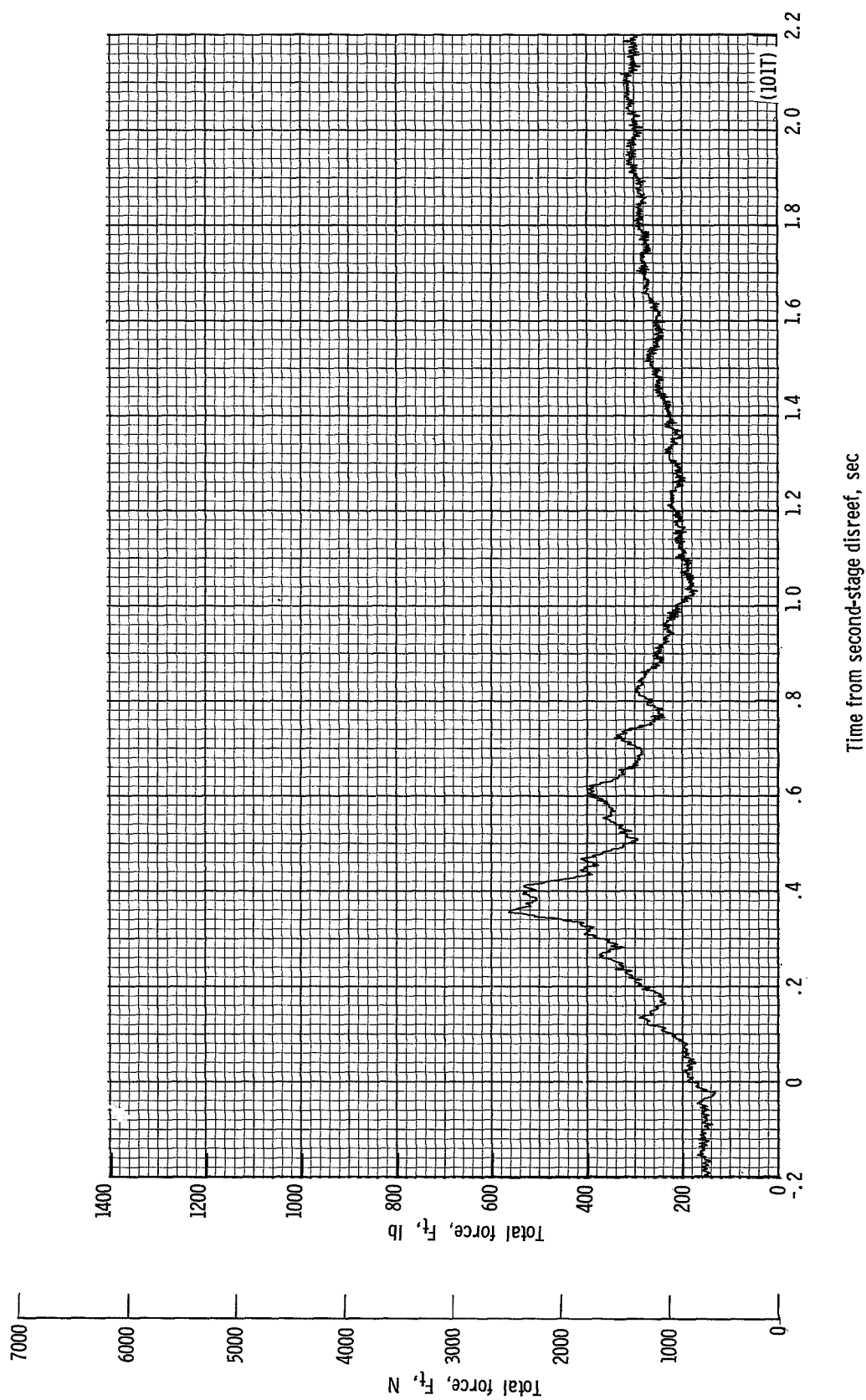
(l) Individual suspension-line loads F_{Lie1} , F_{LK12} , and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 32.34 seconds after launch.

Figure 23.- Continued.



(m) Accelerations a_z , a_y , and a_x plotted against time from second-stage disreef. Time = 0 second corresponds to 32.34 seconds after launch.

Figure 23.- Continued.



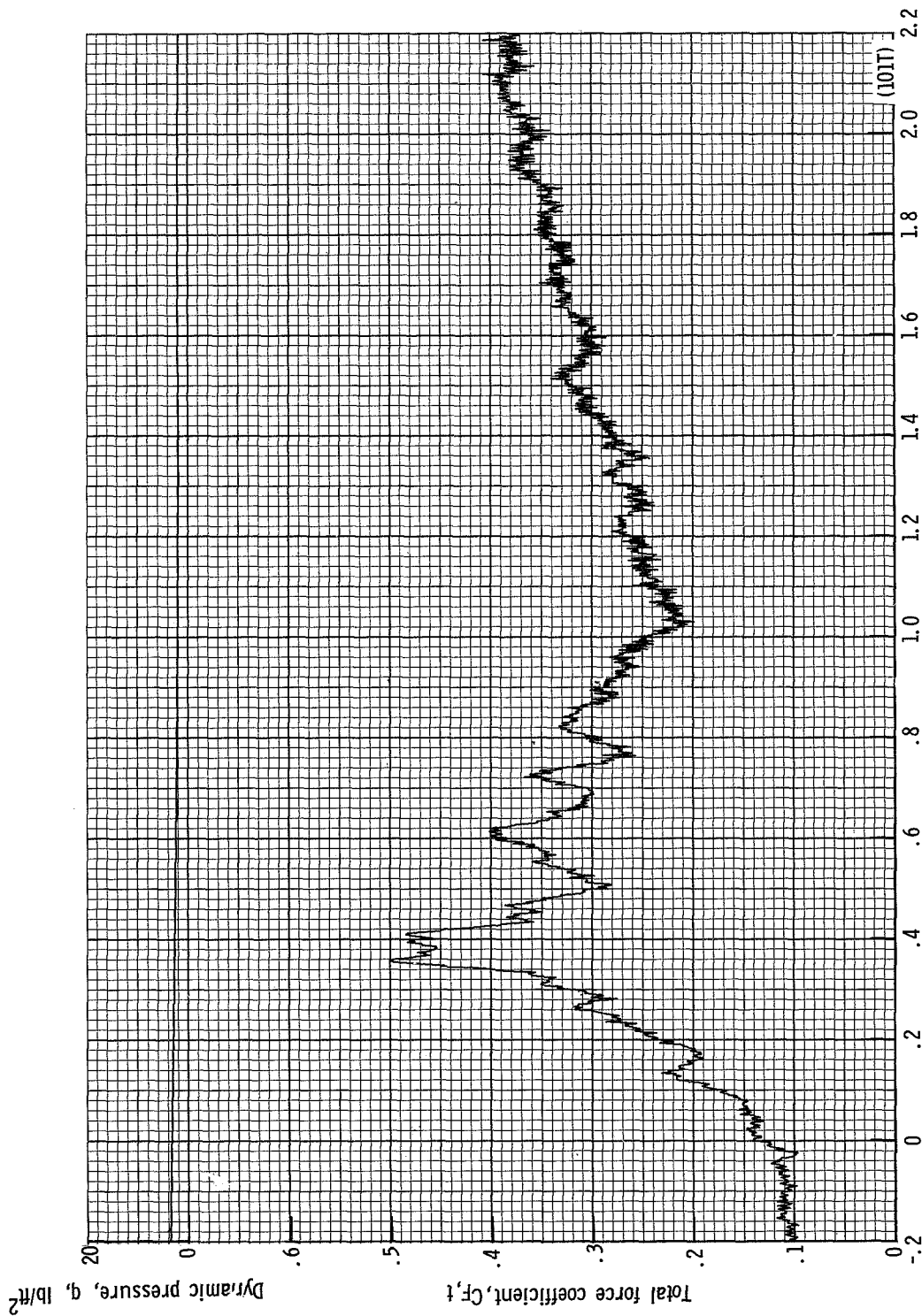
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 32.34 seconds after launch.

Figure 23.- Continued.

Dynamic pressure, q , N/m²

1000

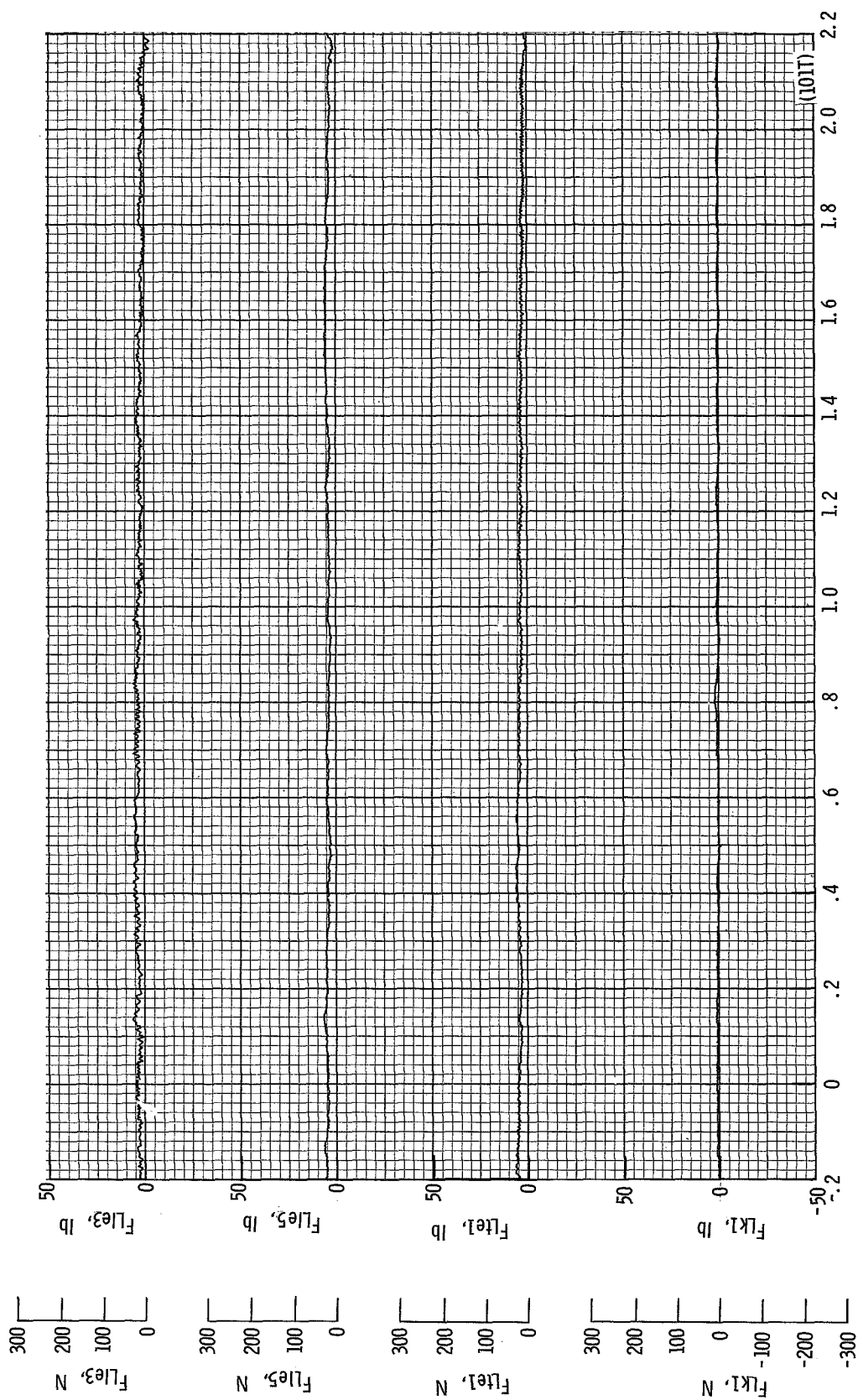
0



Time from second-stage disreef, sec

(c) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 32.34 seconds after launch.

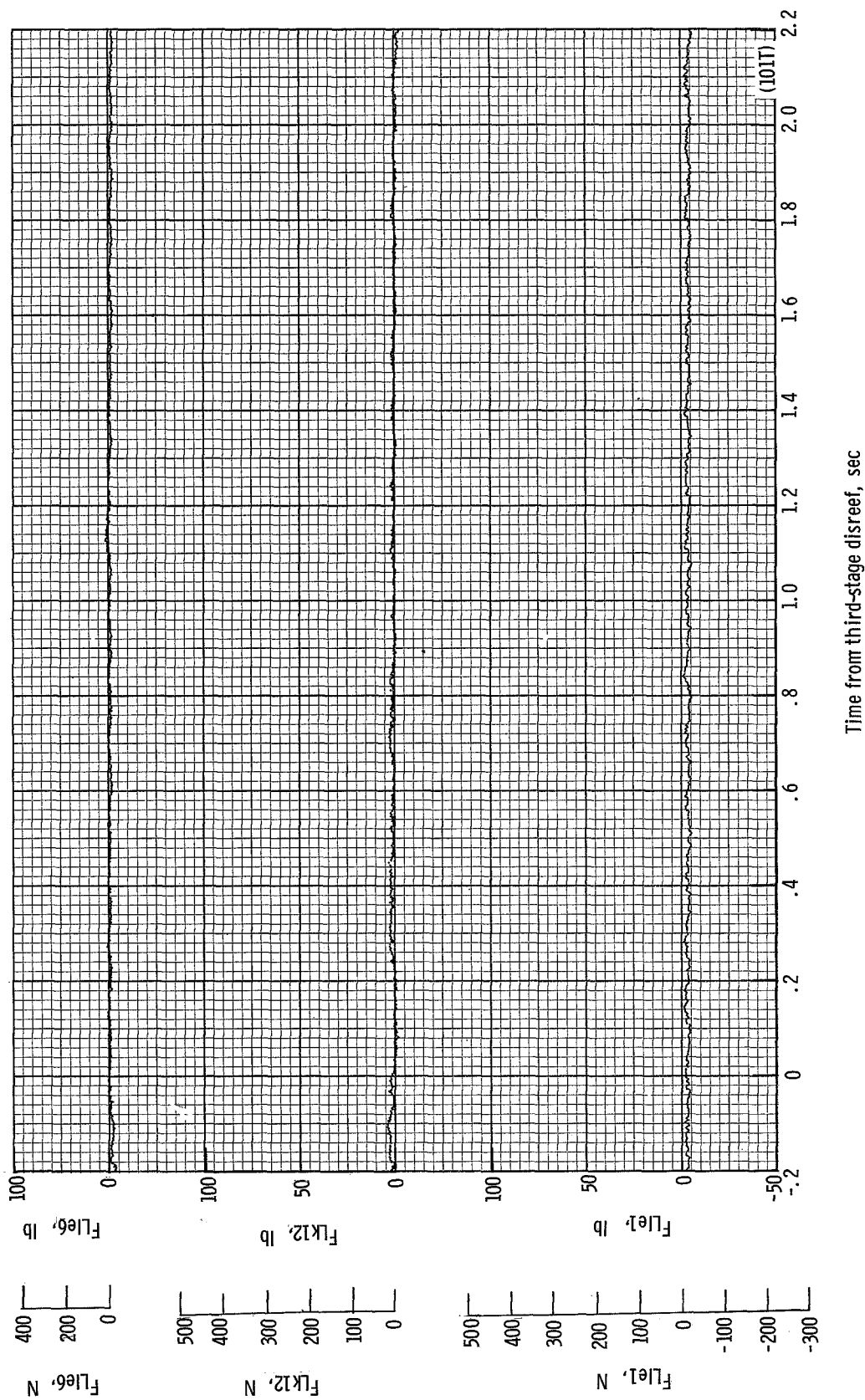
Figure 23.- Continued.



Time from third-stage disreef, sec

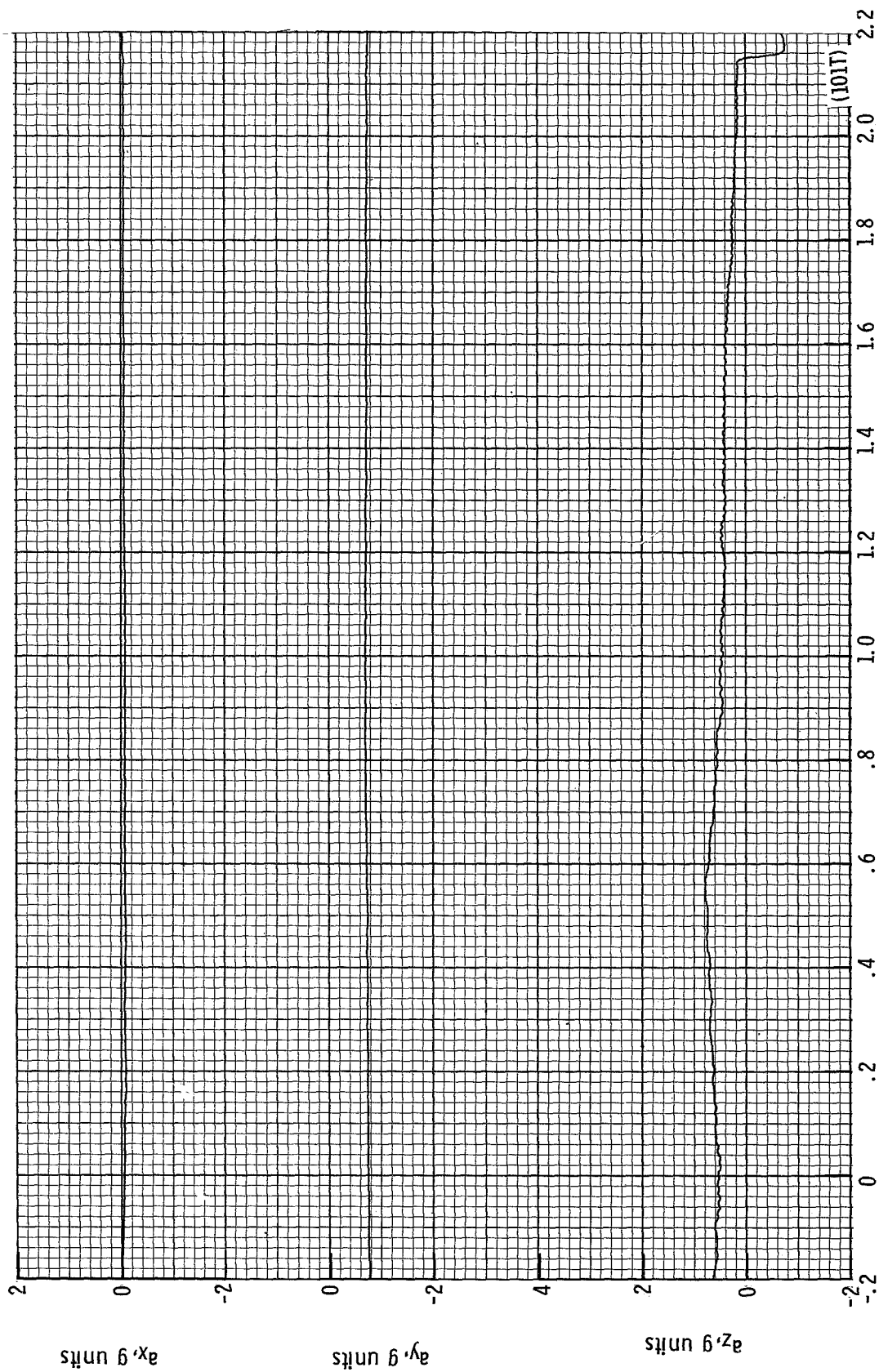
(p) Individual suspension-line loads $FLK1$, $FLT1$, $FLT5$, and $FLT3$ plotted against time from third-stage disreef. Time = 0 second corresponds to 36.79 seconds after launch.

Figure 23.- Continued.



(q) Individual suspension-line loads F_{Lle1} , F_{LK12} , and F_{Lle6} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.79 seconds after launch.

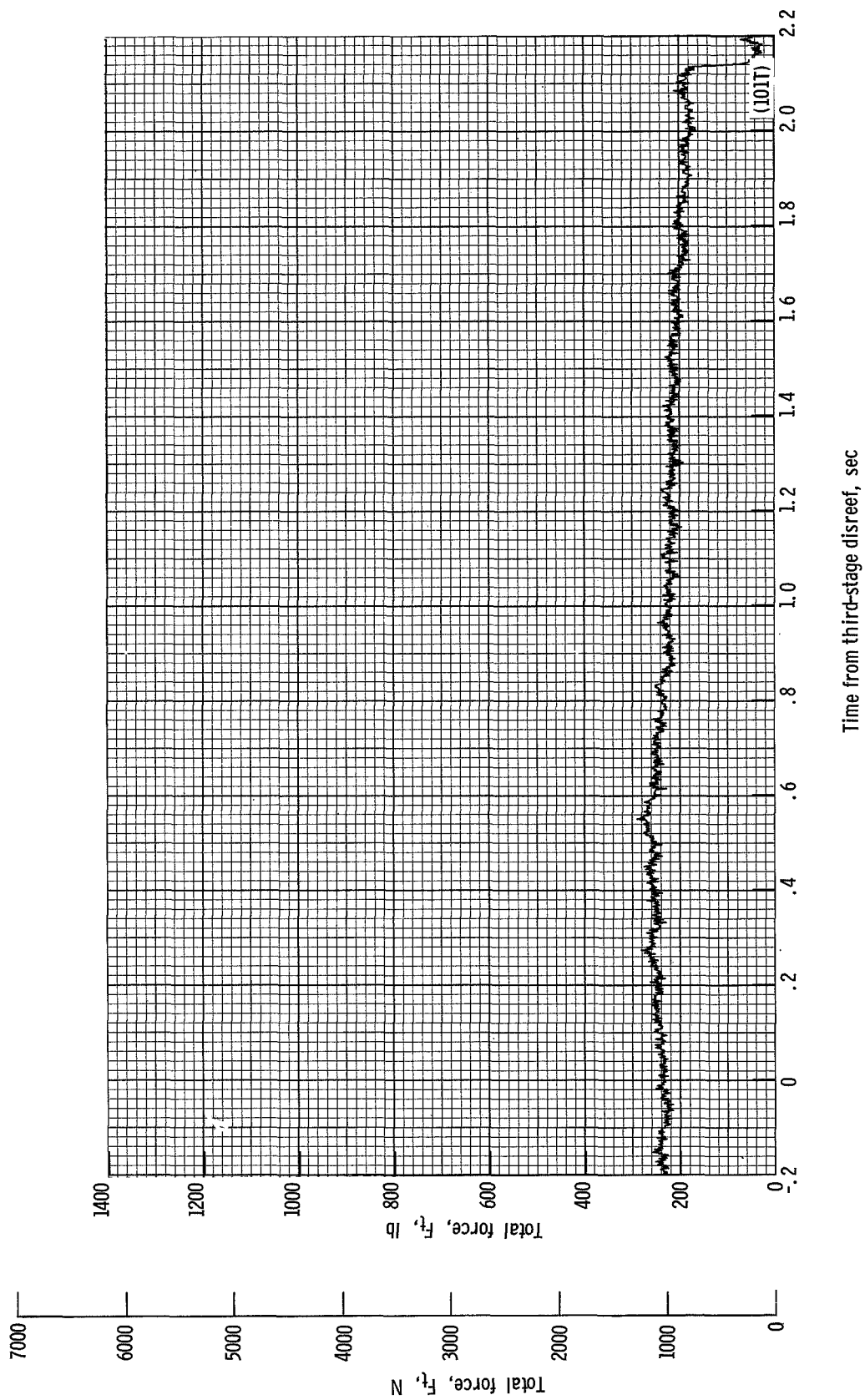
Figure 23.- Continued.



Time from third-stage disreef, sec

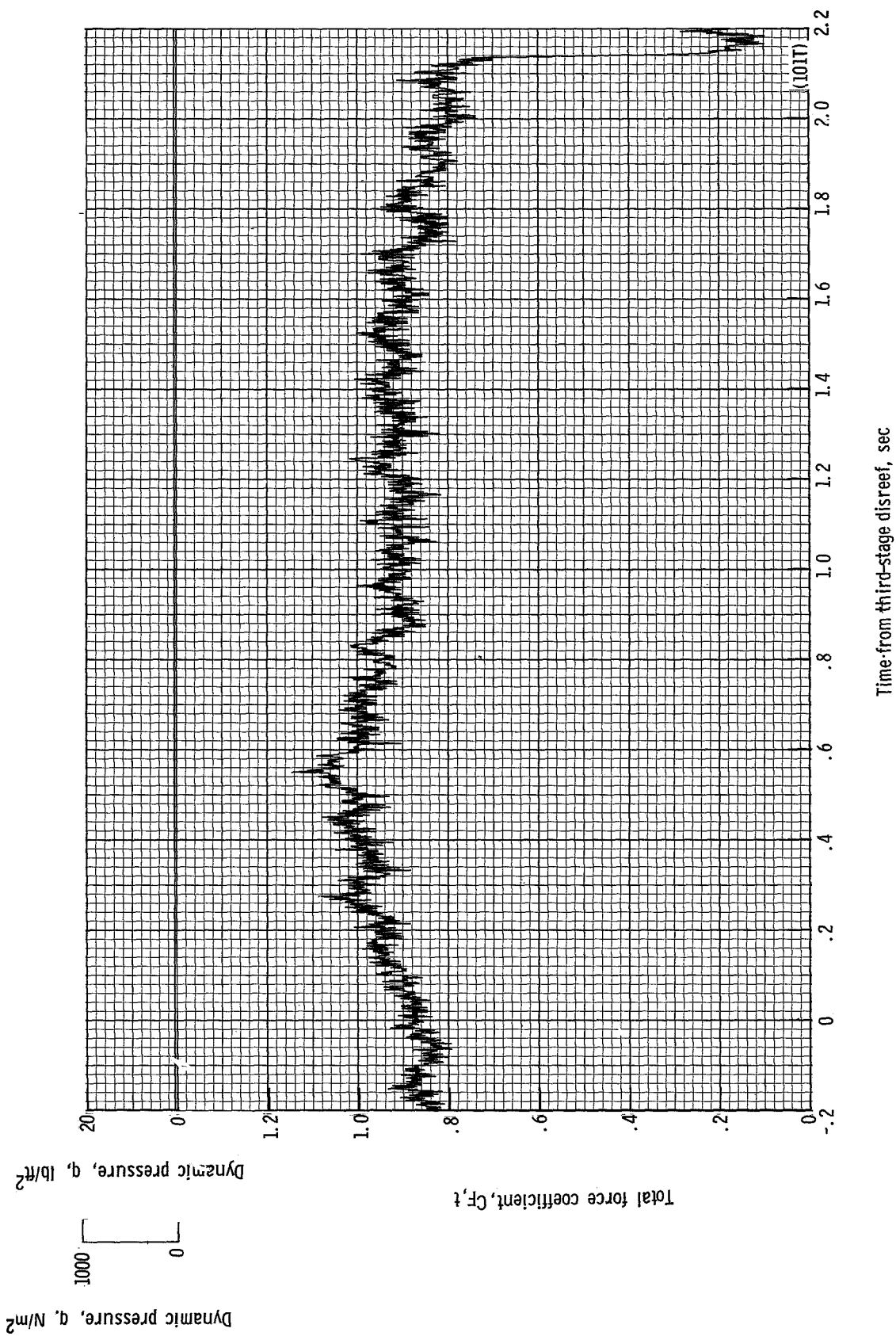
(r) Accelerations a_z , a_y , and a_x plotted against time from third-stage disreef. Time = 0 second corresponds to 36.79 seconds after launch.

Figure 23.- Continued.



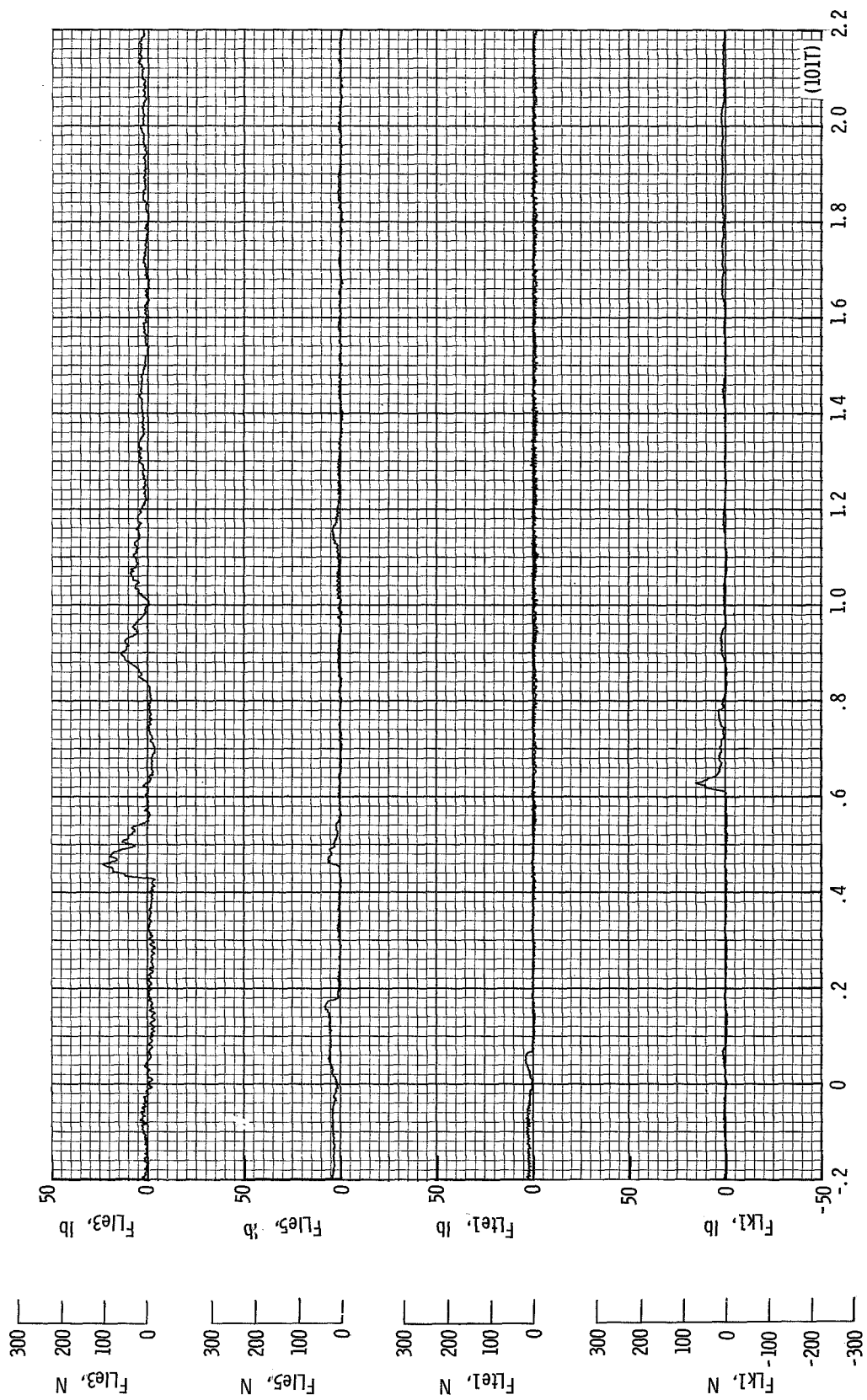
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.79 seconds after launch.

Figure 23.- Continued.



(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.79 seconds after launch.

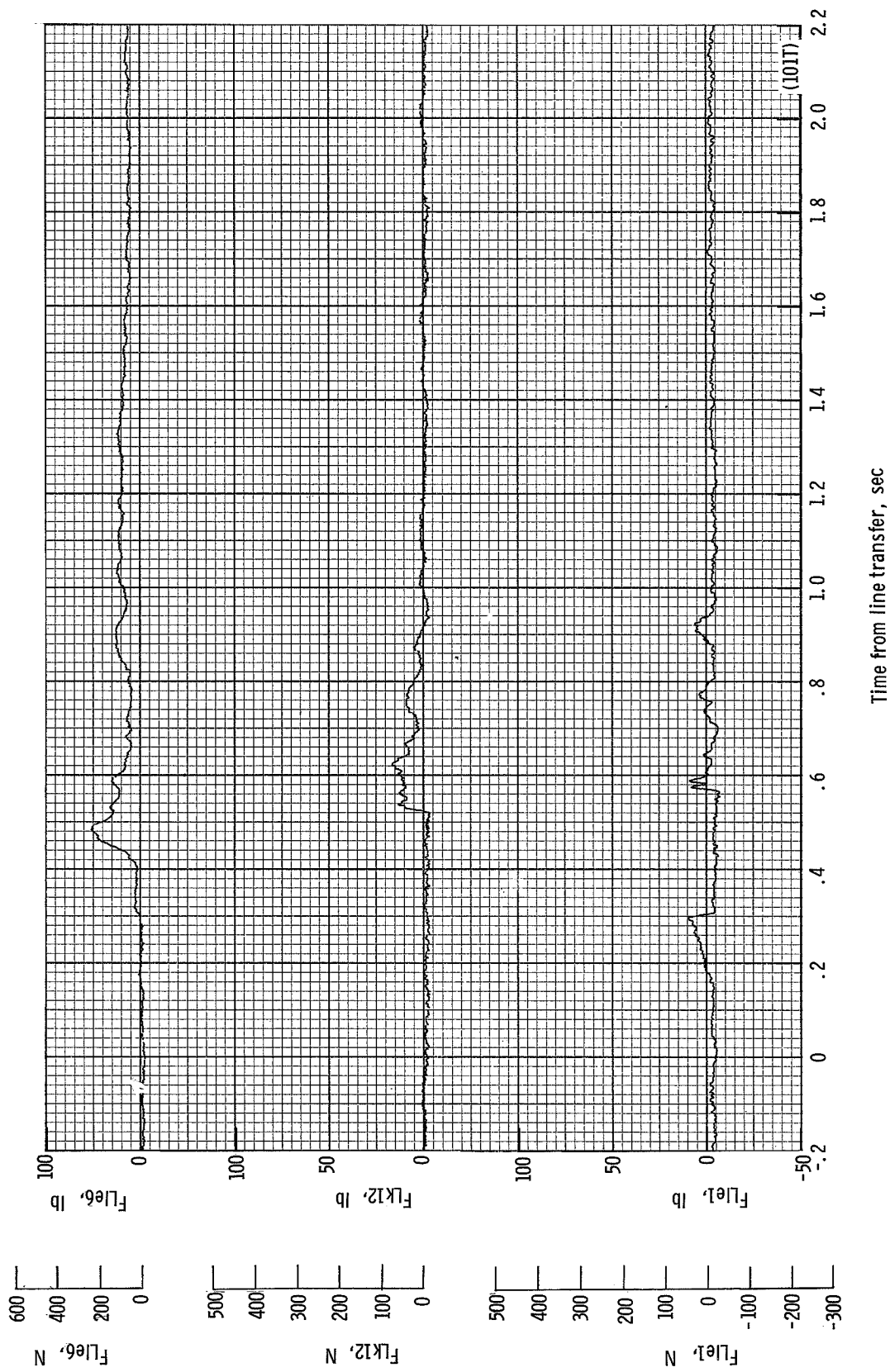
Figure 23. - Continued.



Time from line transfer, sec

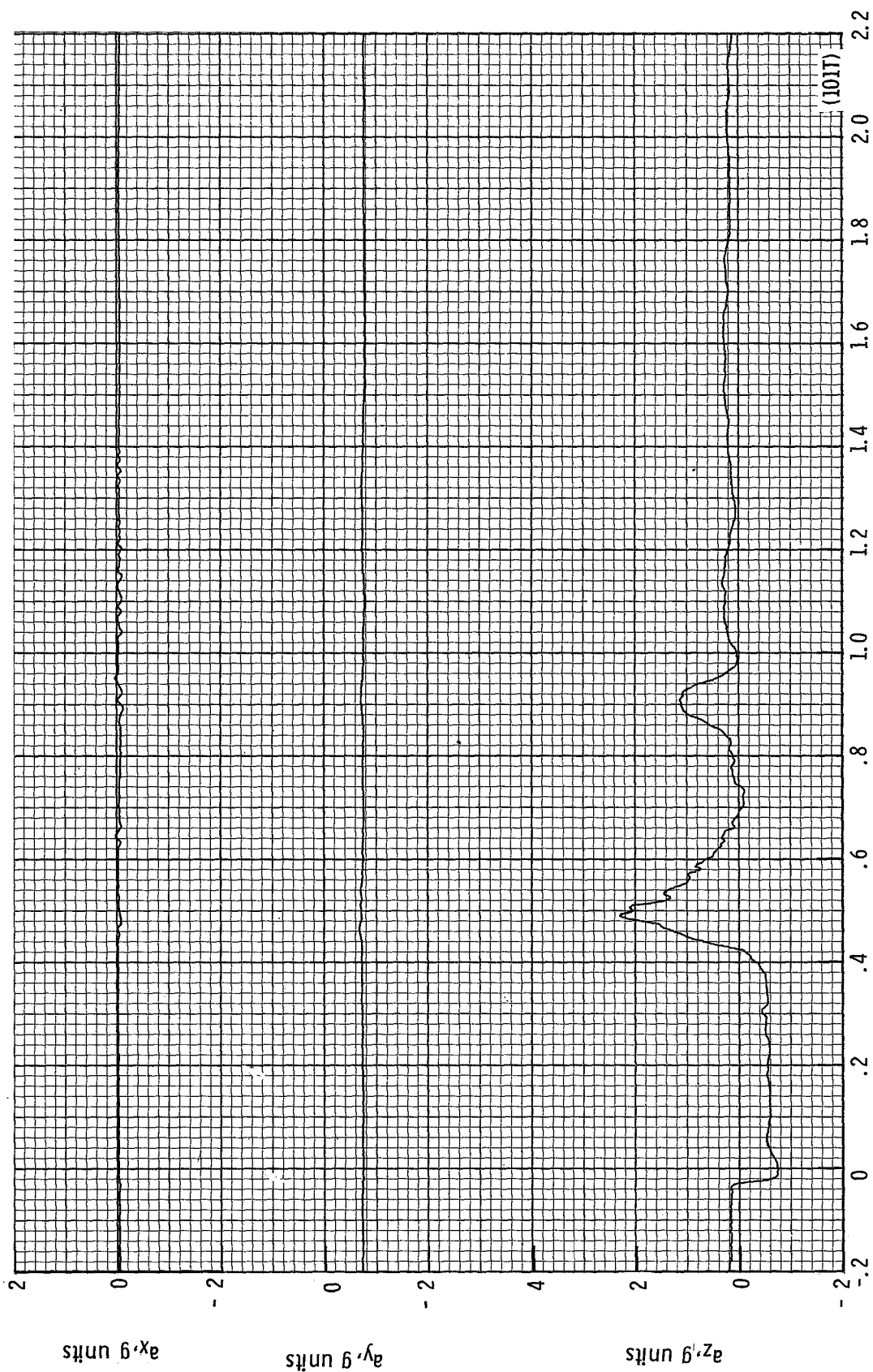
(u) Individual suspension-line loads F_{Lk1} , F_{Lte1} , F_{Lle5} , and F_{Lle3} plotted against time from line transfer. Time = 0 second corresponds to 38.97 seconds after 'launch.

Figure 23.- Continued.



(v) Individual suspension-line loads F_{Lle1} , F_{LK12} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 38.97 seconds after launch.

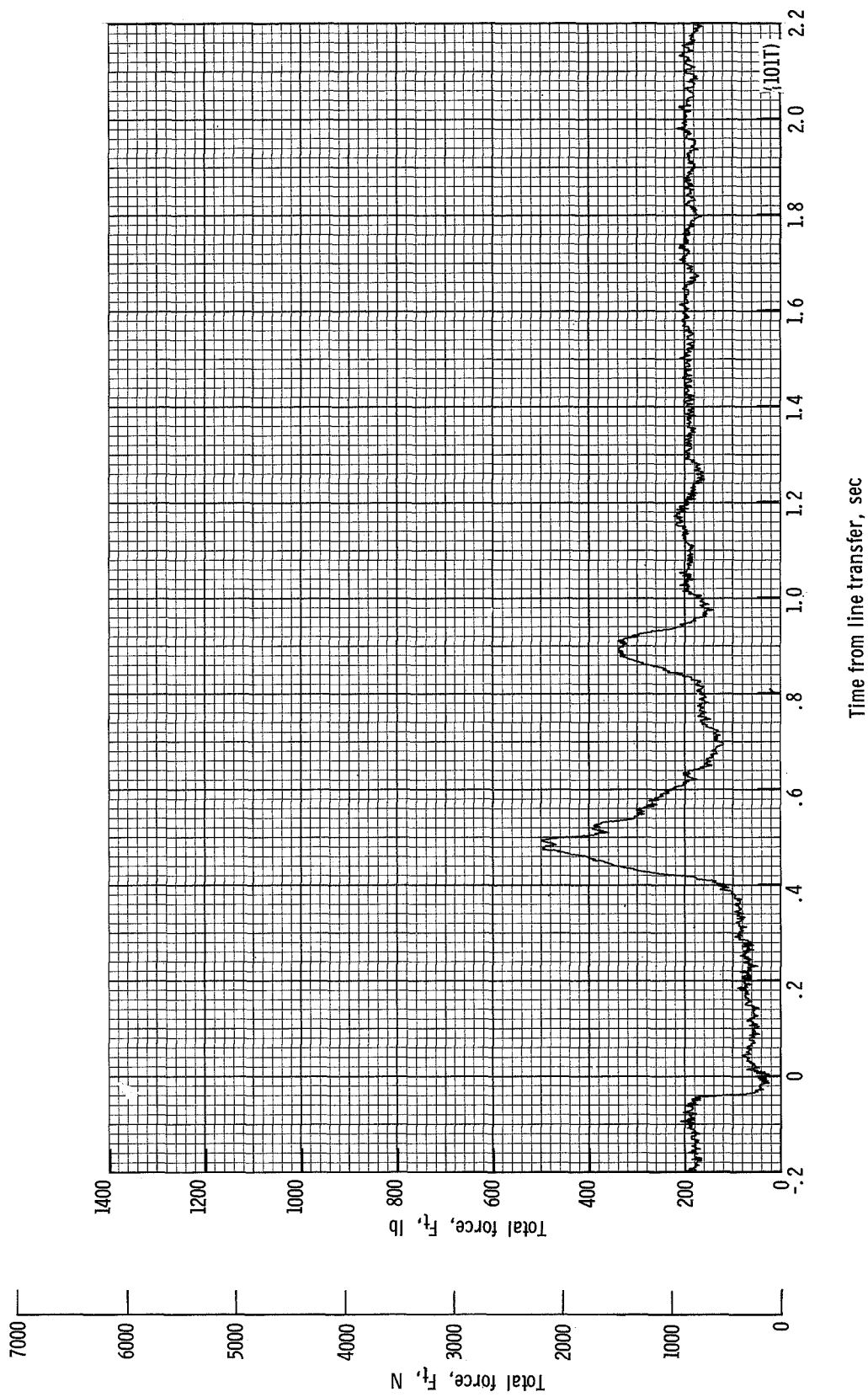
Figure 23.- Continued.



Time from line transfer, sec

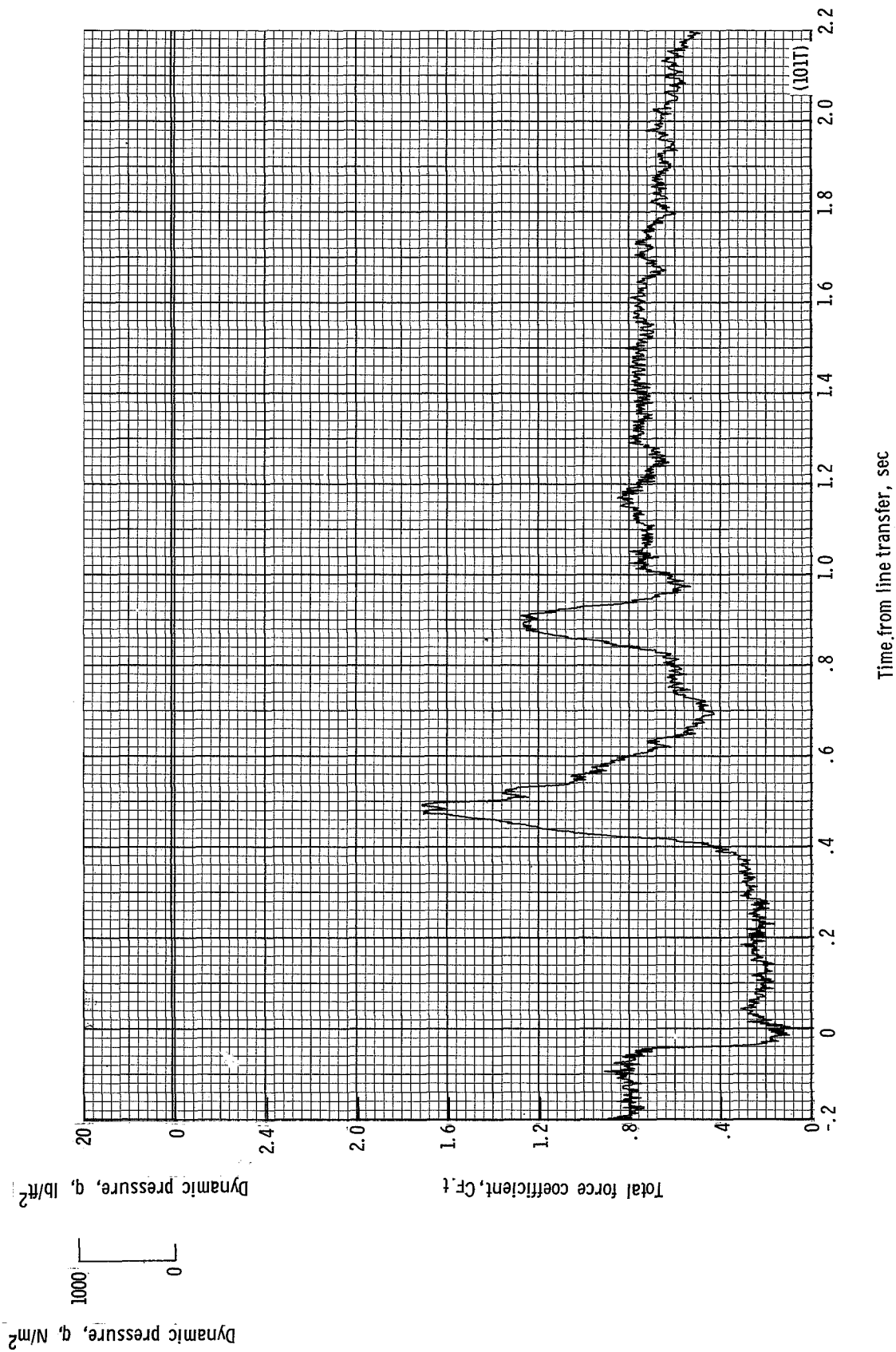
(w) Accelerations a_z , a_y , and a_x plotted against time from line transfer. Time = 0 second corresponds to 38.97 seconds after launch.

Figure 23.- Continued.



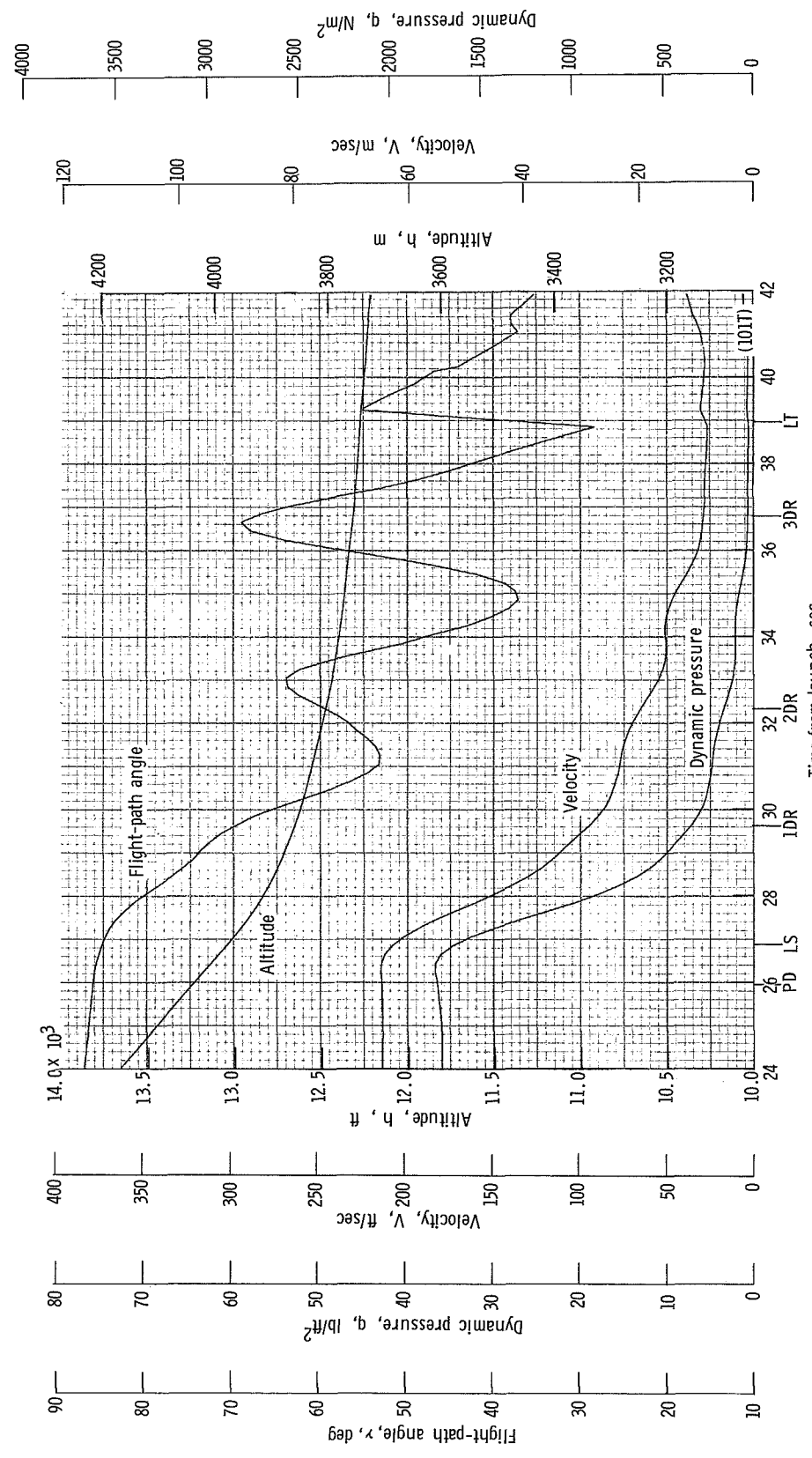
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 38.97 seconds after launch.

Figure 23.- Continued.



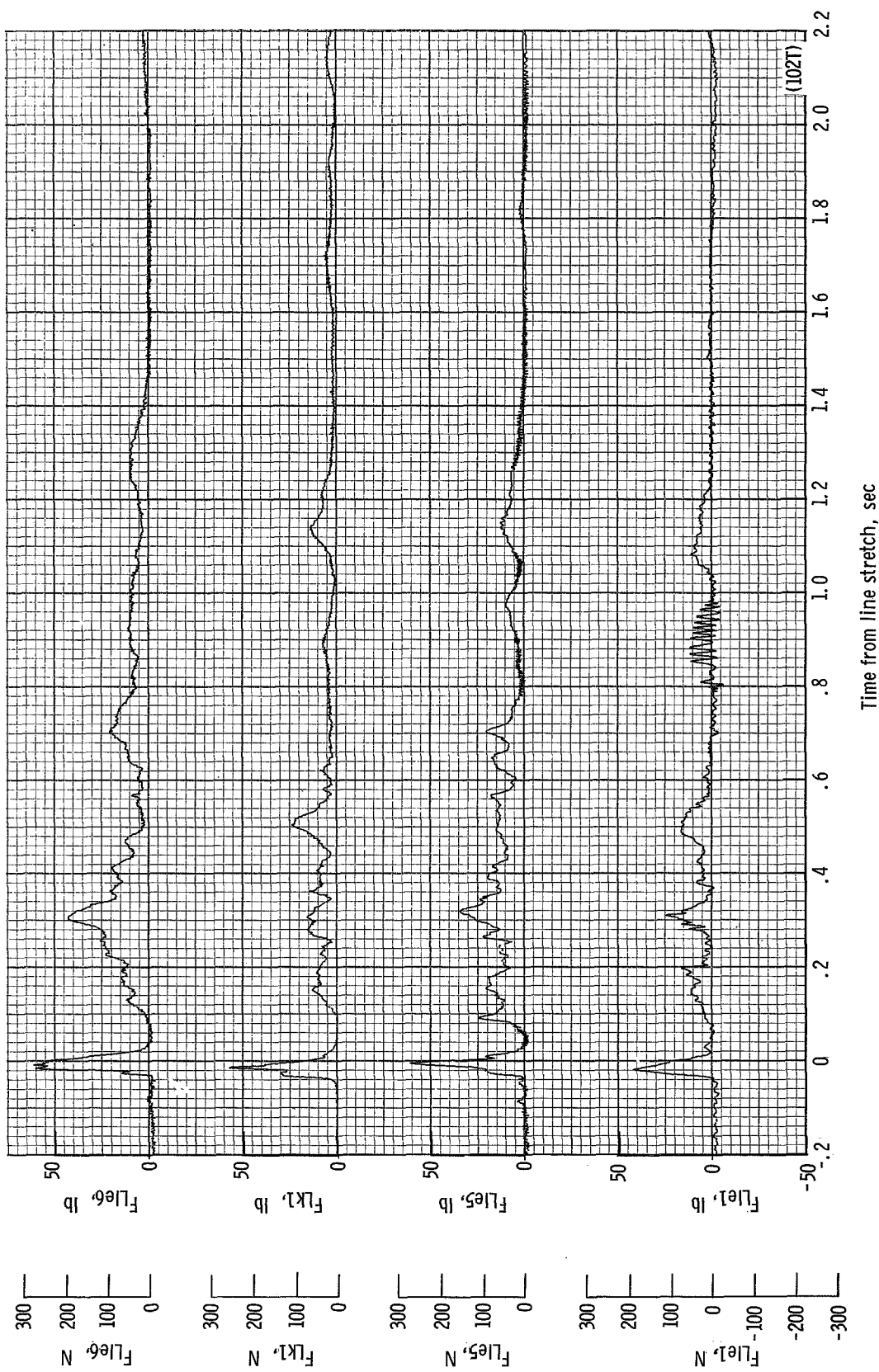
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 38.97 seconds after launch.

Figure 23.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

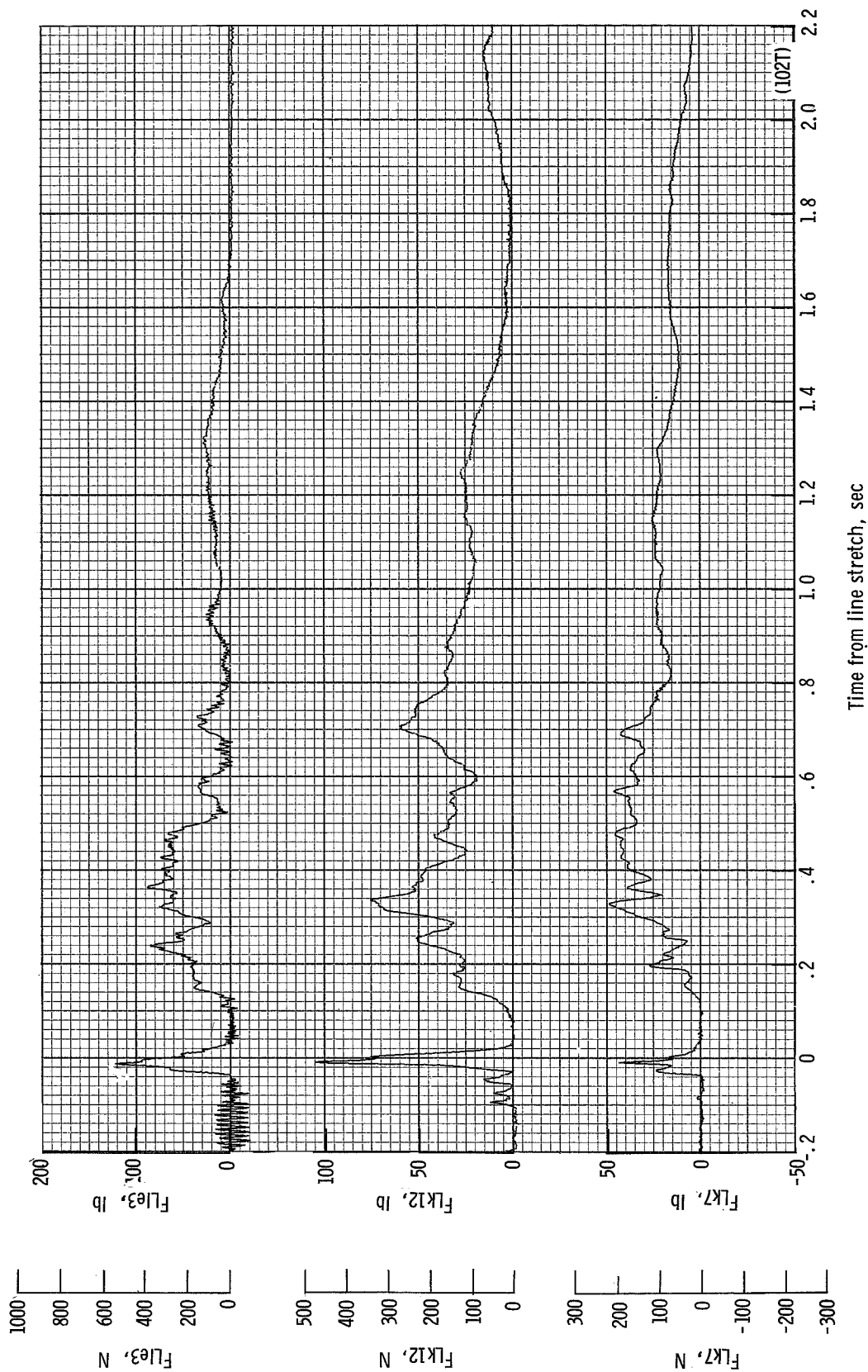
Figure 23.- Concluded.



(a) Individual suspension-line loads F_{Lle1} , F_{Lle5} , F_{Lk1} , and F_{Lle6} plotted against time from line stretch. Time = 0 second corresponds to 28.03 seconds after launch.

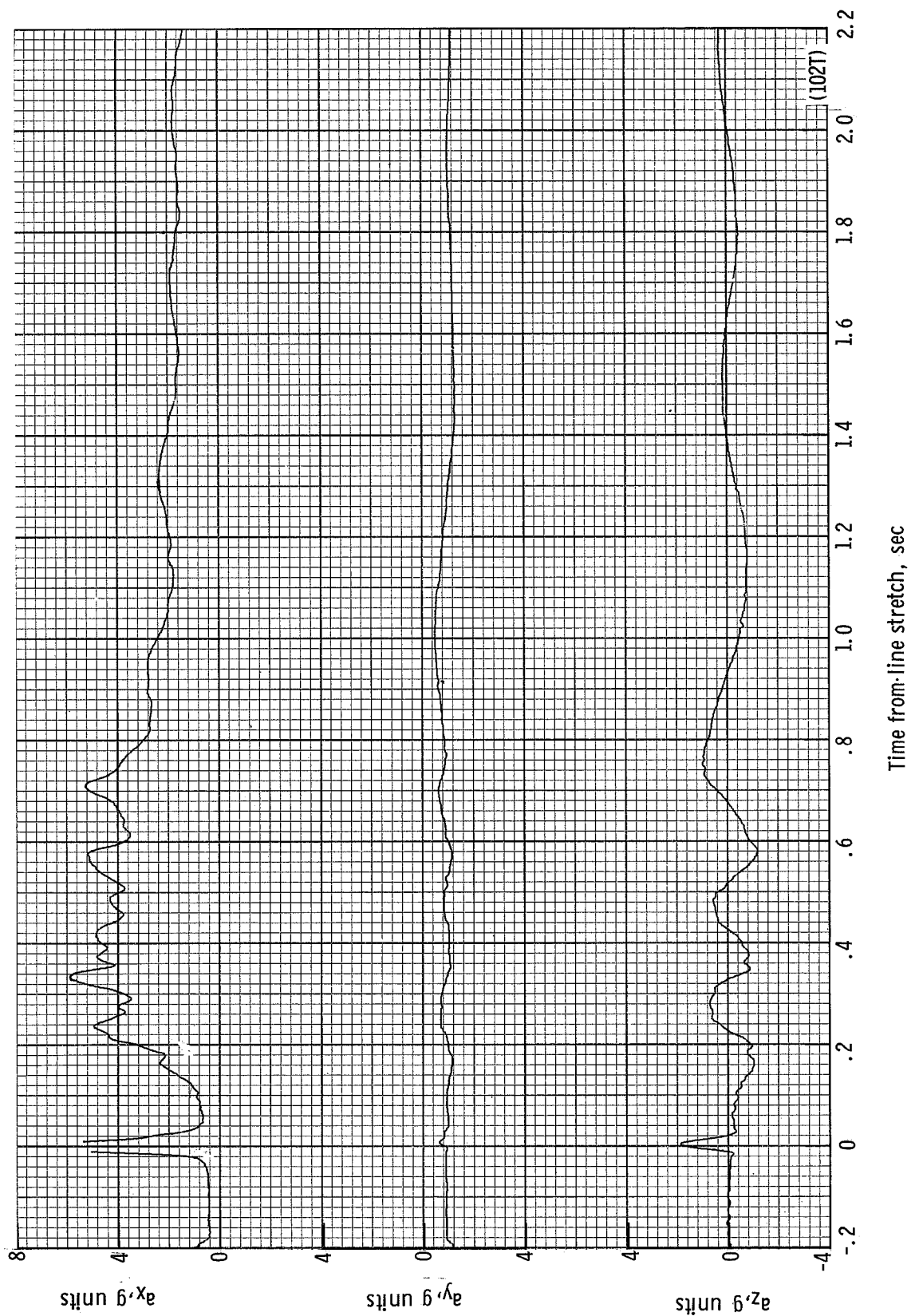
Figure 24.- Time history of twin-keel parawing deployment data for test 102T. $W_D = 1130.7$ N (254.2 lb); $W_P = 975.5$ N (219.3 lb); $q_{PD} = 1718.1$ N/m² (37.2 lb/ft²).

$h_{PD} = 1222$ m (4010 ft); $l_r/l_k = 0.219$; reefing version II.



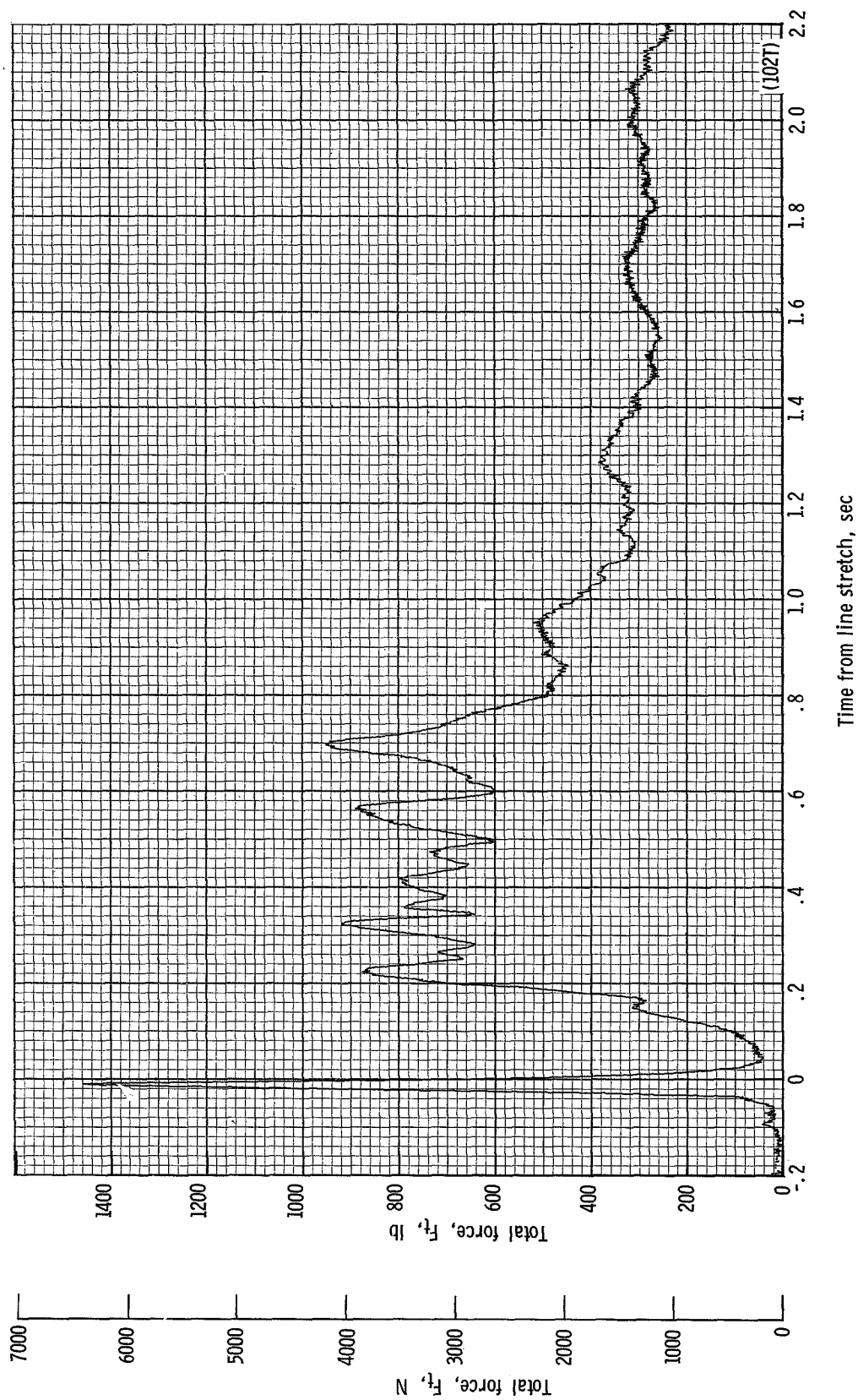
(b) Individual suspension-line loads $FLK7$, $FLK12$, and $FLIe3$ plotted against time from line stretch. Time = 0 second corresponds to 28.03 seconds after launch.

Figure 24.- Continued.



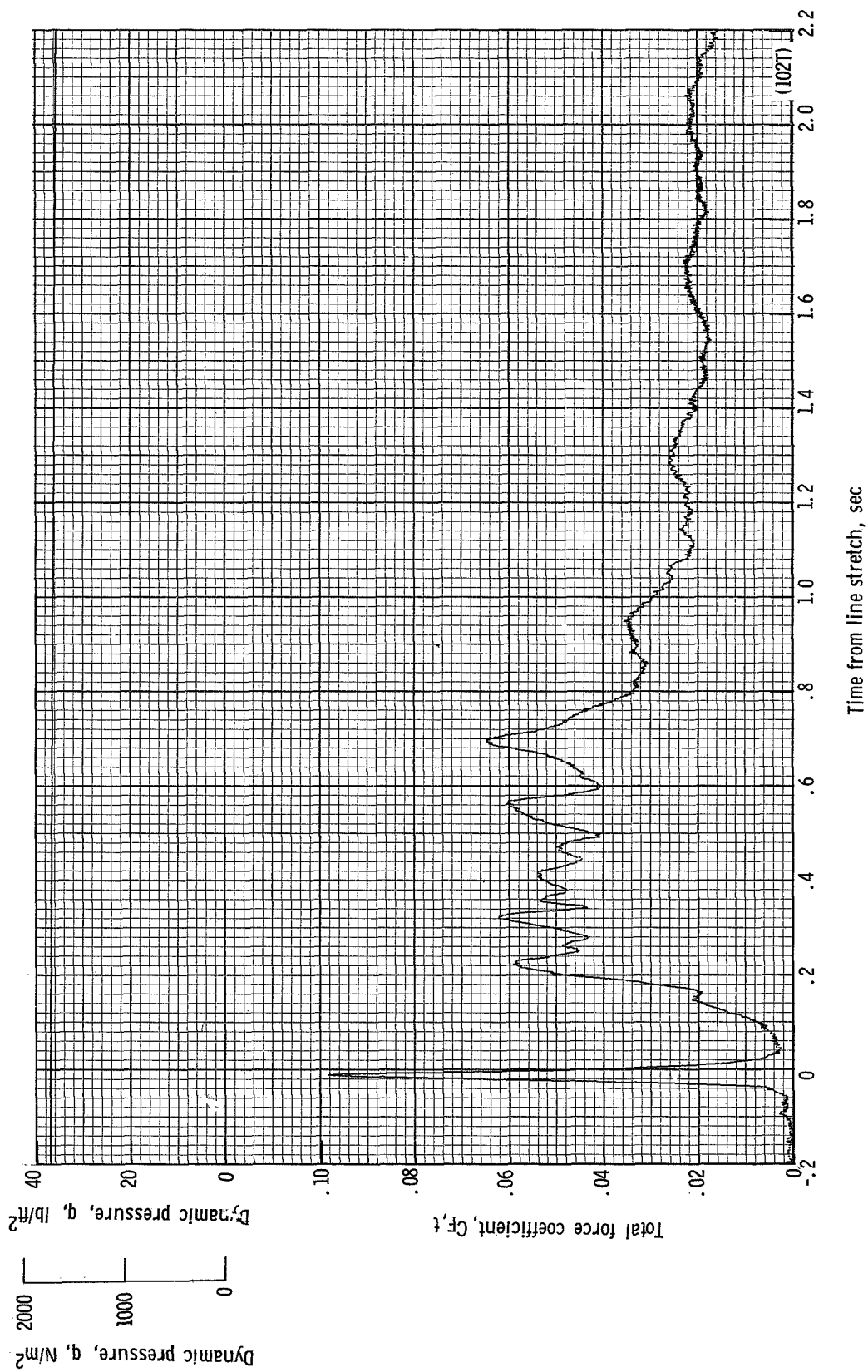
(c) Accelerations a_z , a_y , and a_x plotted against time from line stretch. Time = 0 second corresponds to 28.03 seconds after launch.

Figure 24.- Continued.



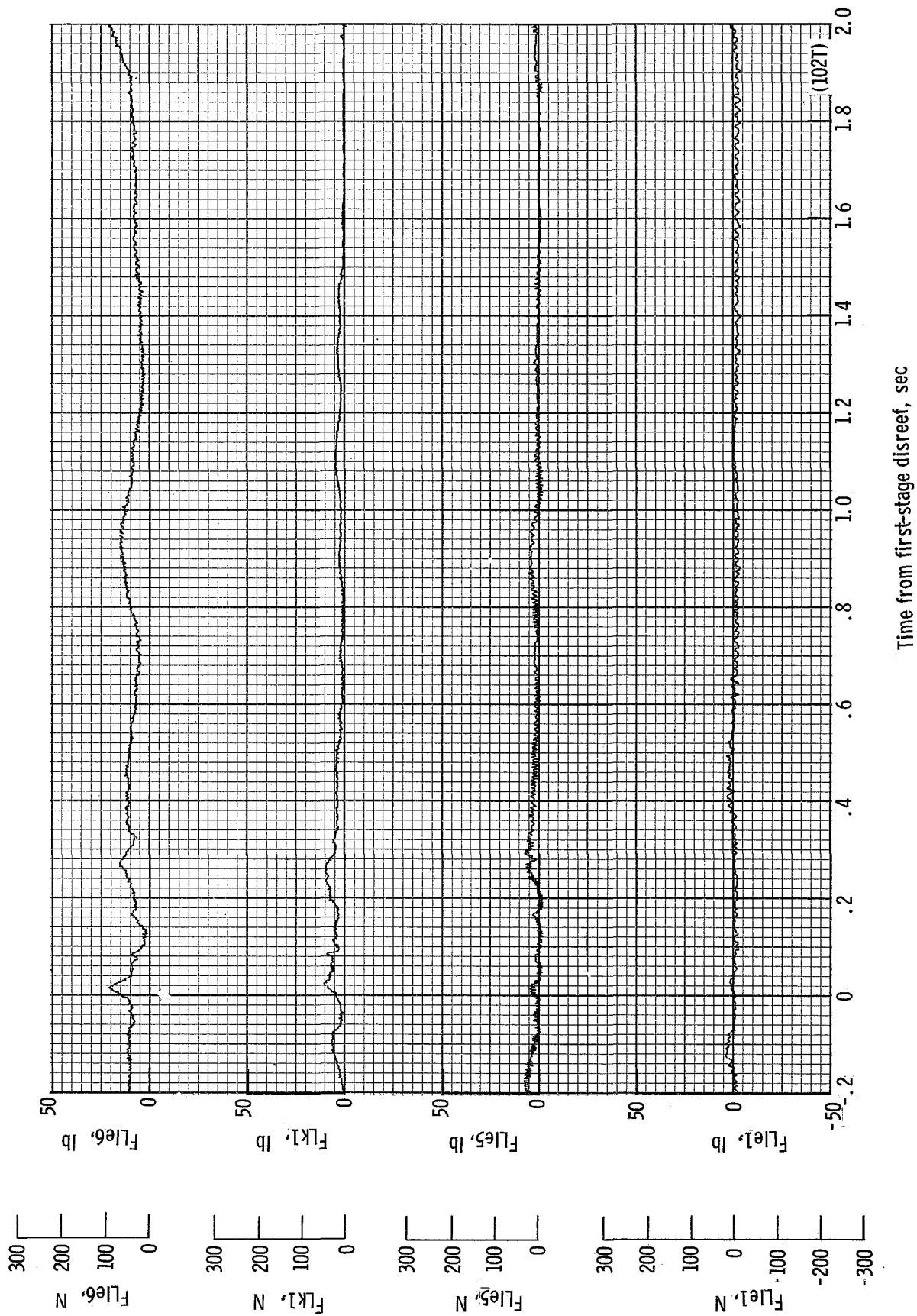
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 28.03 seconds after launch.

Figure 24.- Continued.



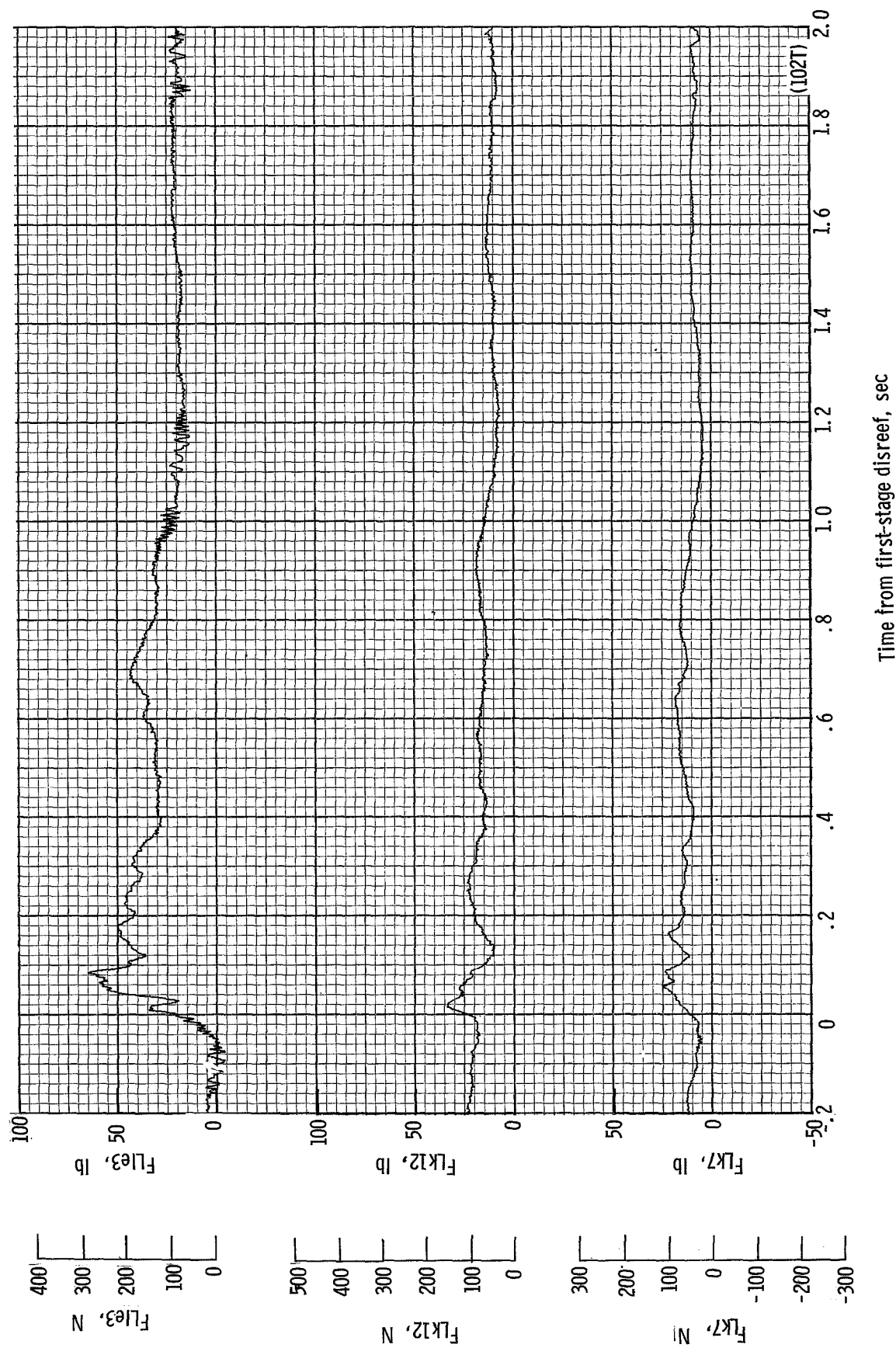
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 28.03 seconds after launch.

Figure 24.- Continued.



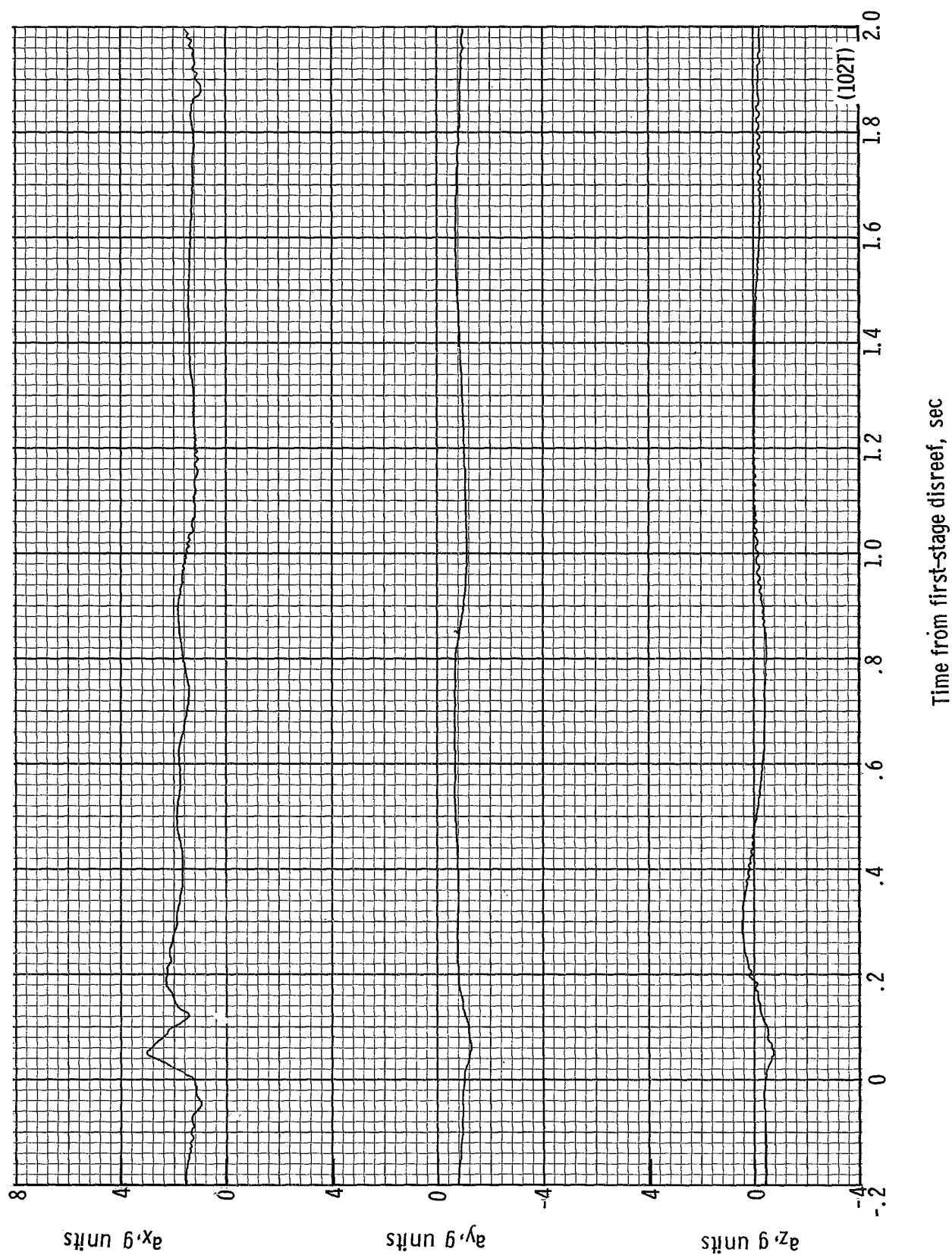
(f) Individual suspension-line loads F_{Lle1} , F_{Lle5} , F_{Lk1} , and F_{Lle6} plotted against time from first-stage disreef. Time = 0 second corresponds to 31.31 seconds after launch.

Figure 24. - Continued.



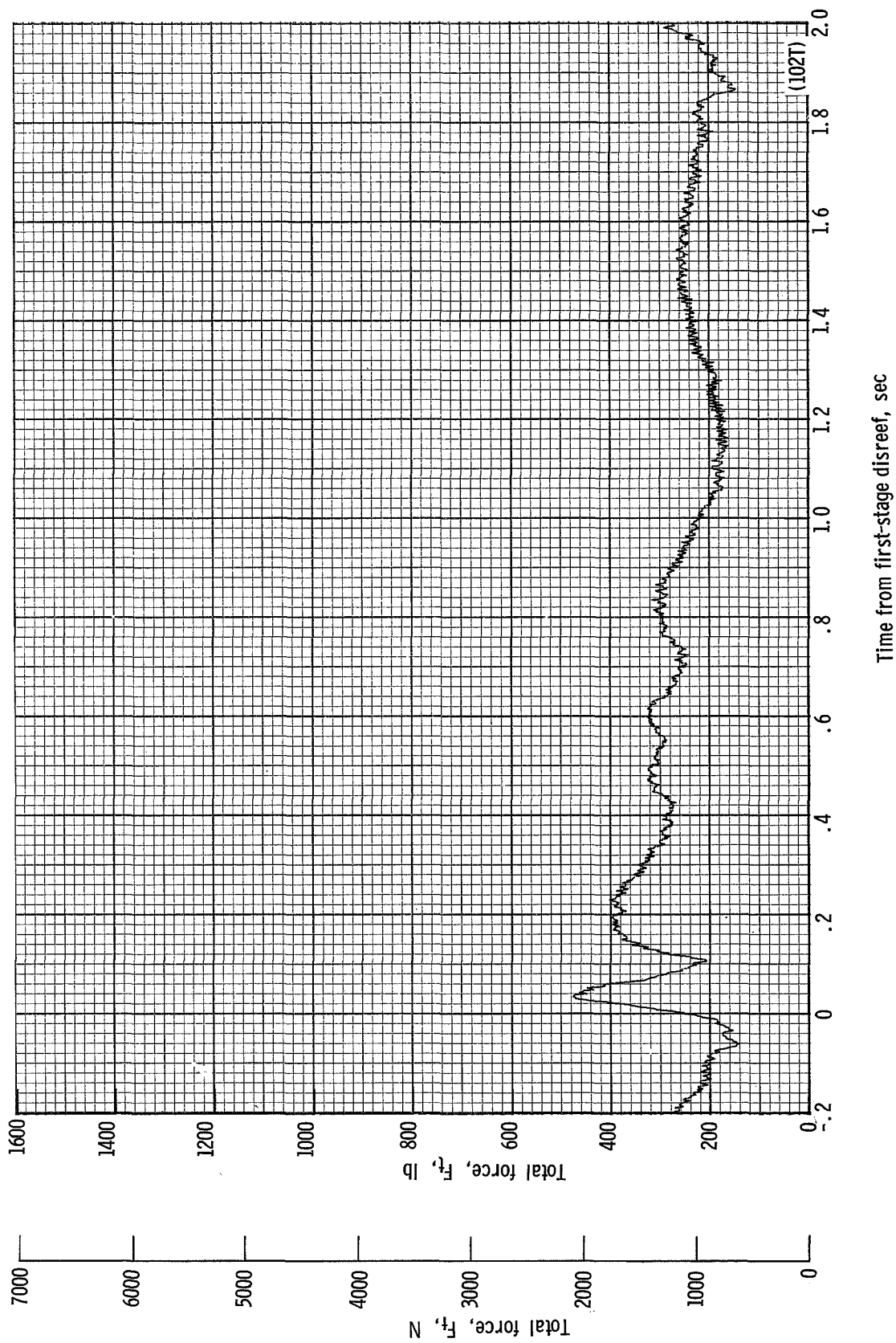
(g) Individual suspension-line loads F_{LK7} , F_{LK12} , and F_{Lle3} plotted against time from first-stage disreef. Time = 0 second corresponds to 31.31 seconds after launch.

Figure 24.- Continued.



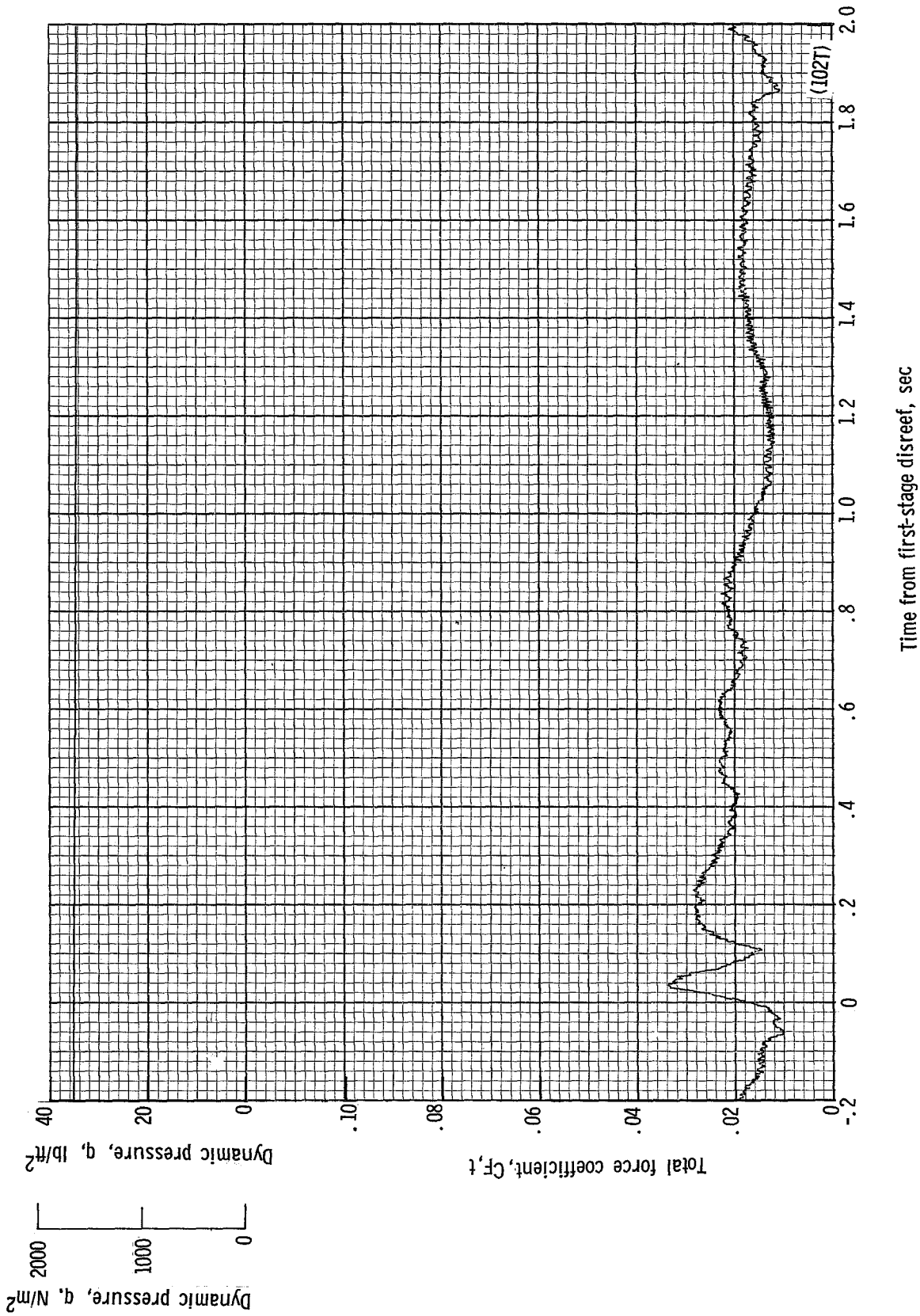
(h) Accelerations a_z , a_y , and a_x plotted against time from first-stage disreef. Time = 0 second corresponds to 31.31 seconds after launch.

Figure 24.- Continued.

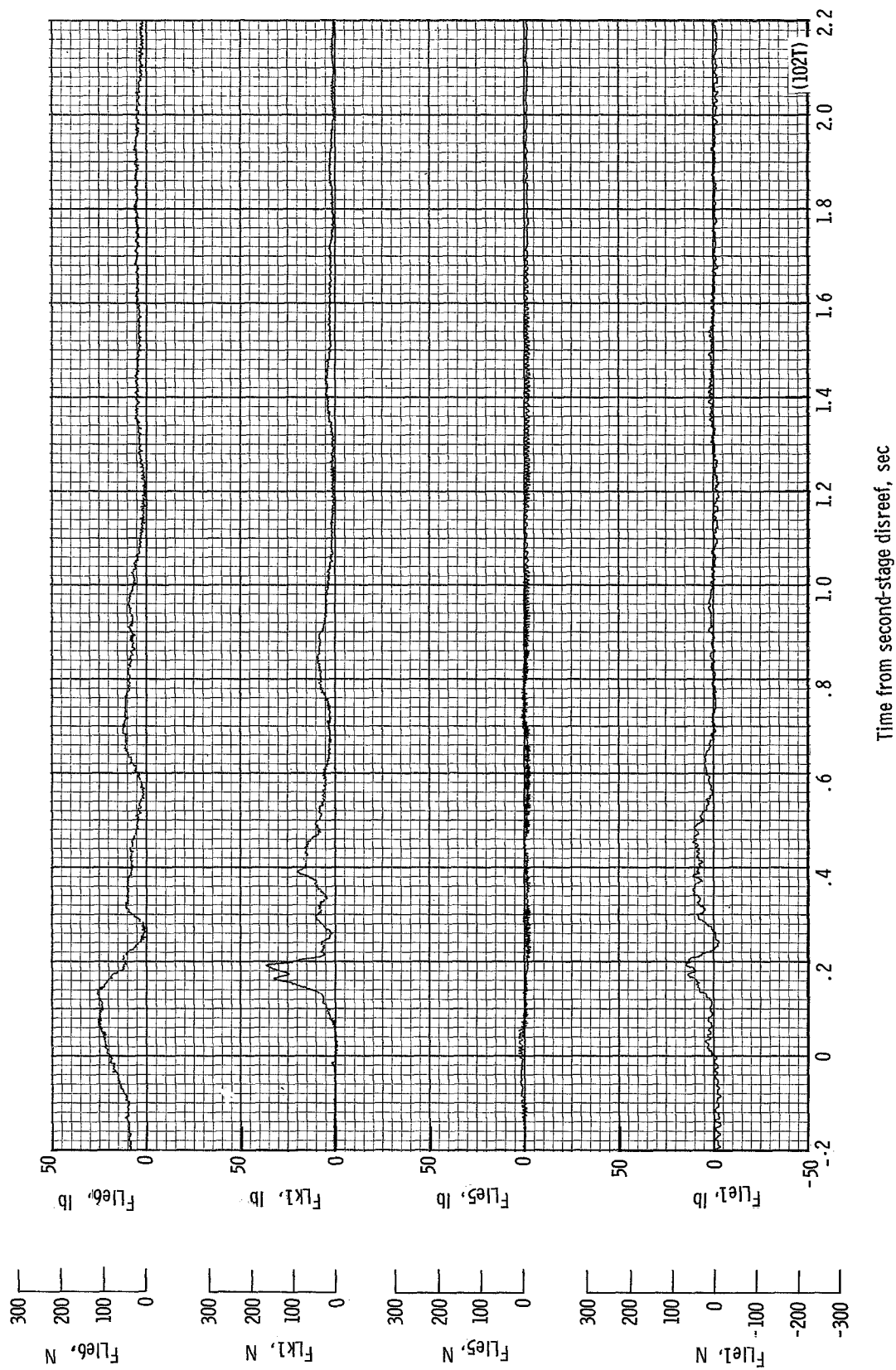


(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 31.31 seconds after launch.

Figure 24.- Continued.

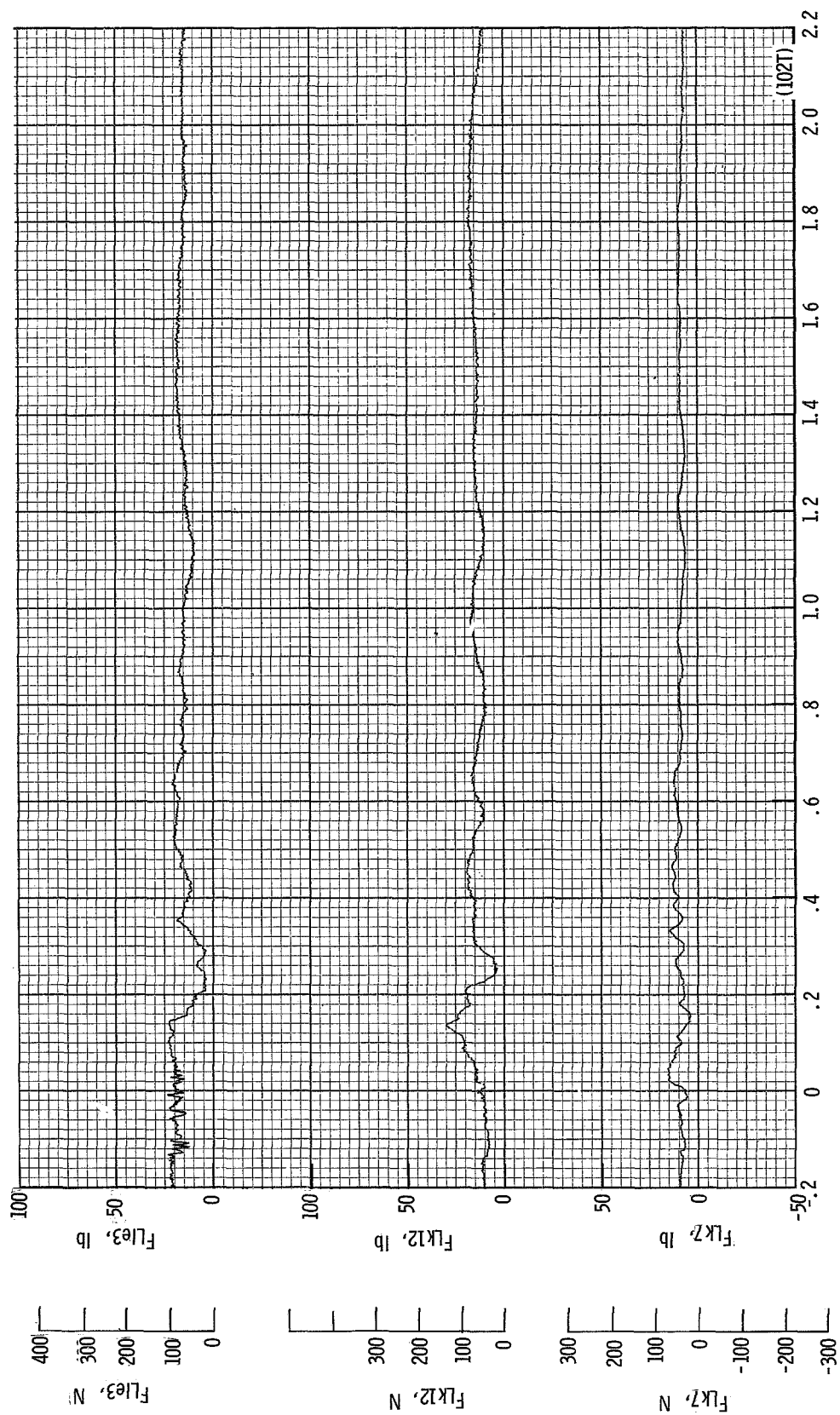


(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 31.31 seconds after launch.
Figure 24.- Continued.



(k) Individual suspension-line loads F_{Lle1} , F_{Lle5} , F_{Lk1} , and F_{Lle6} plotted against time from second-stage disreef. Time = 0 second corresponds to 33.30 seconds after launch.

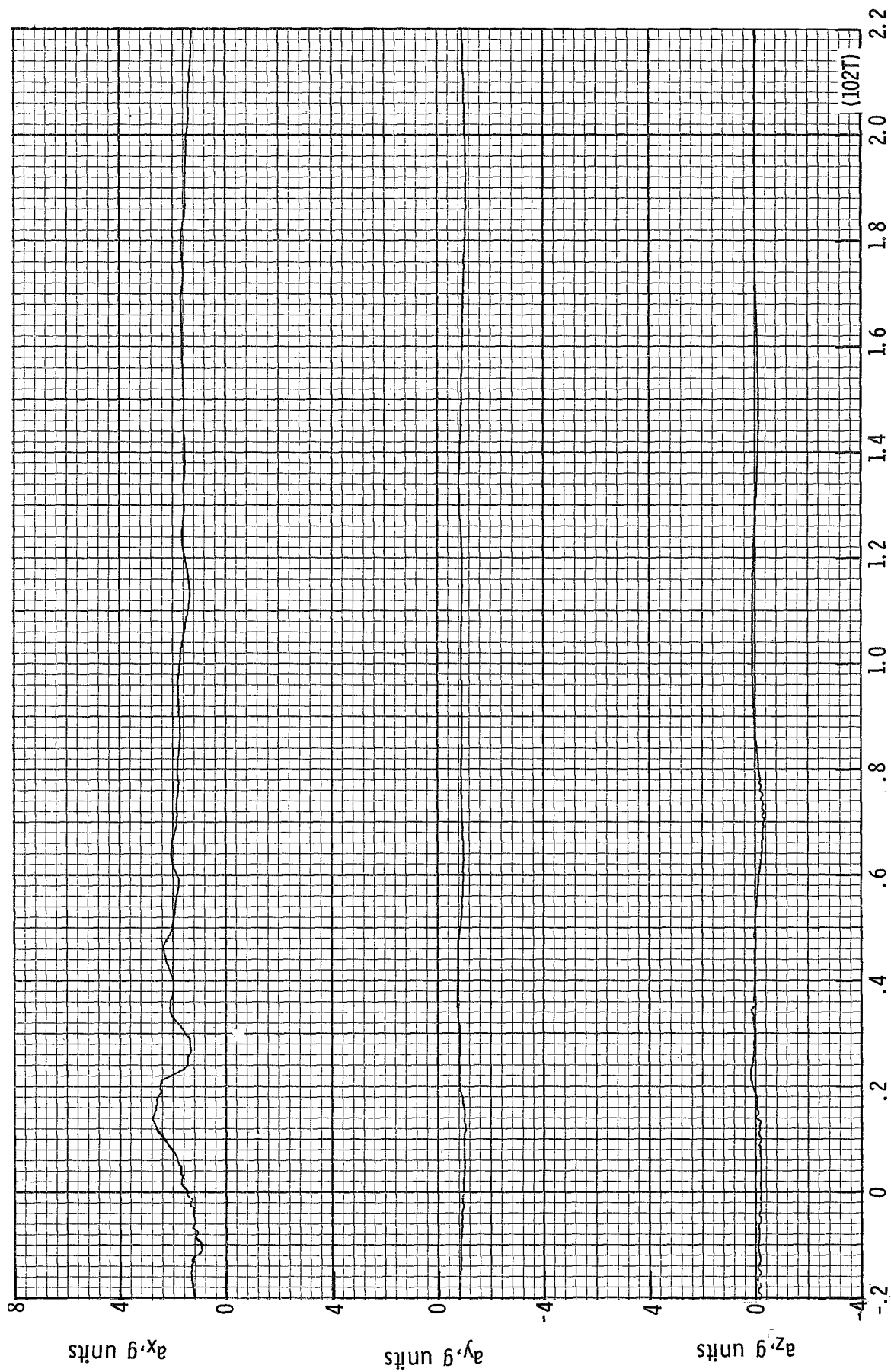
Figure 24.- Continued.



Time from second-stage disreef, sec

(l) Individual suspension-line loads $FLK7$, $FLK12$, and $FLIe3$ plotted against time from second-stage disreef. Time = 0 second corresponds to 33.30 seconds after launch.

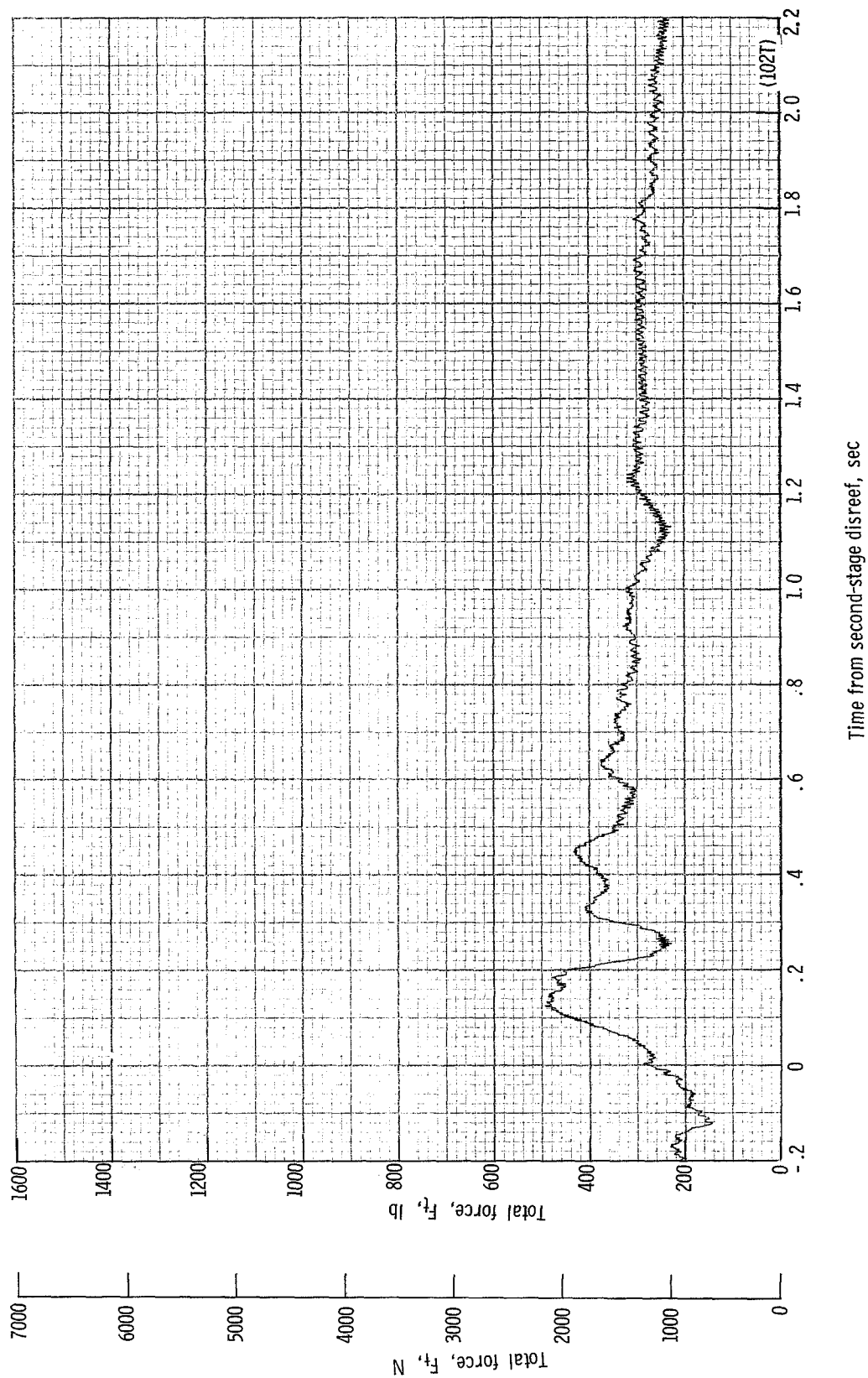
Figure 24.- Continued.



Time from second-stage disreef, sec

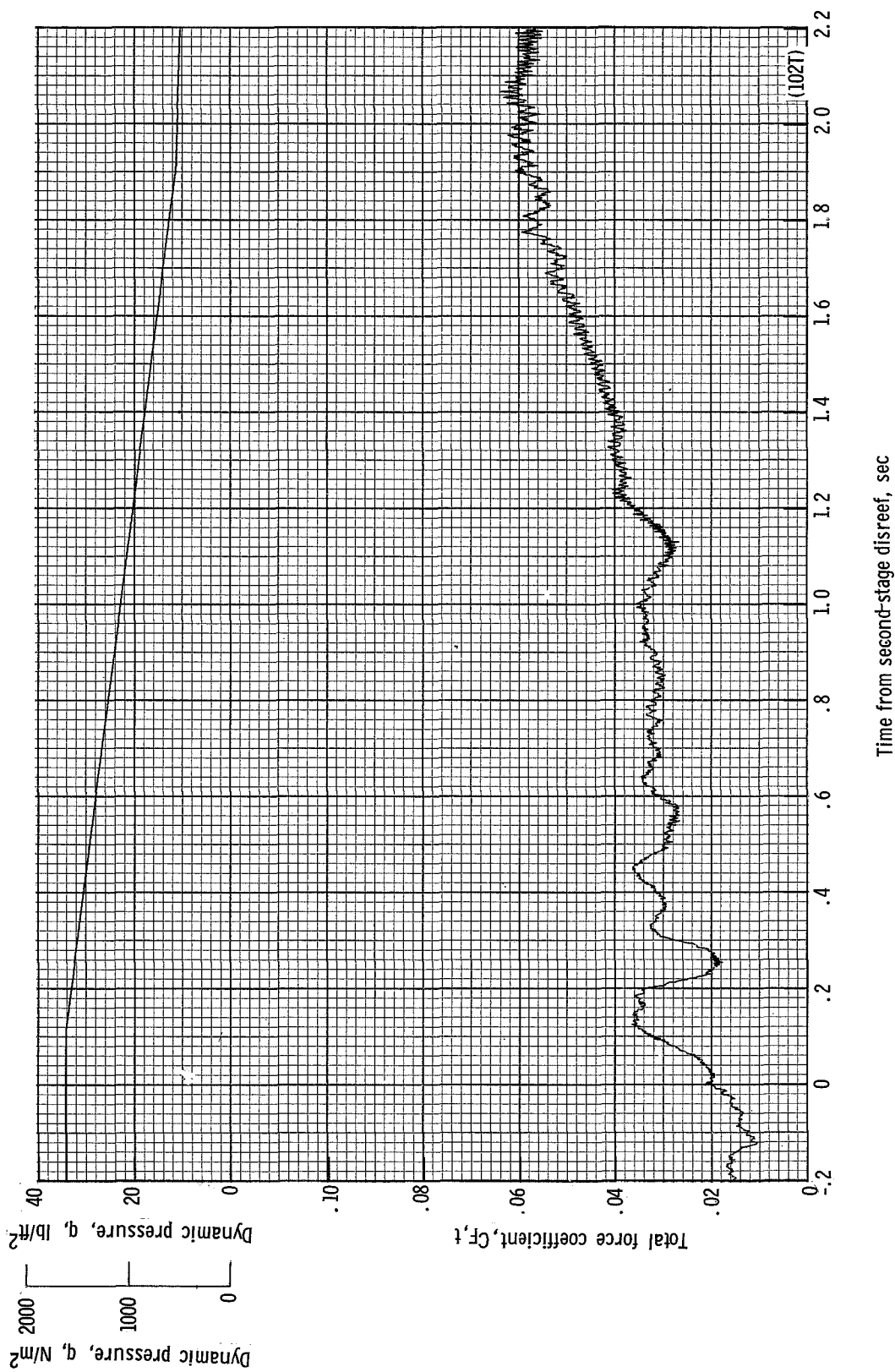
(m) Accelerations a_z , a_y , and a_x plotted against time from second-stage disreef. Time = 0 second corresponds to 33.30 seconds after launch.

Figure 24.- Continued.



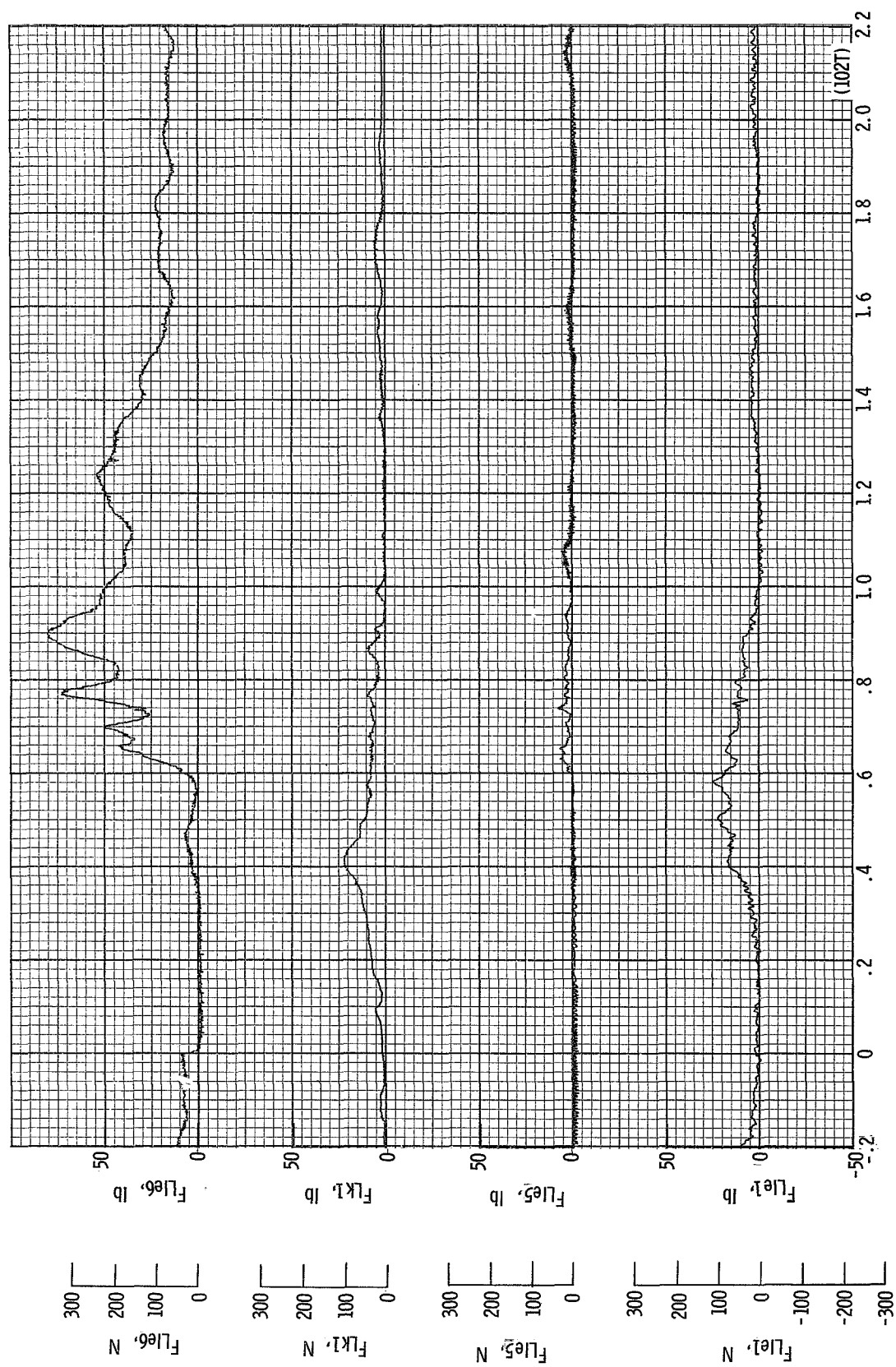
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 33.30 seconds after launch.

Figure 24.- Continued.



(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 33.30 seconds after launch.

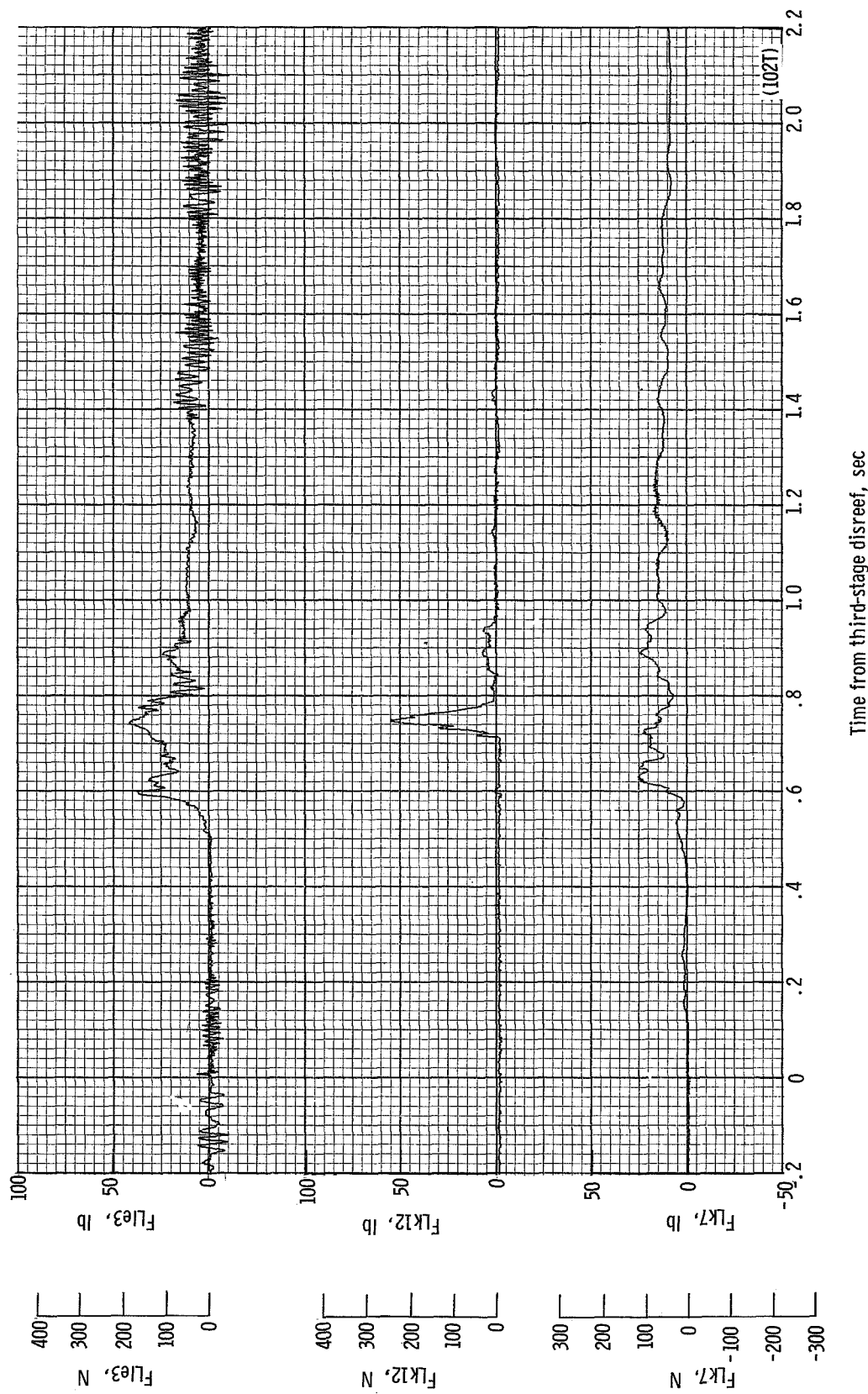
Figure 24.- Continued.



Time from third-stage disreef, sec

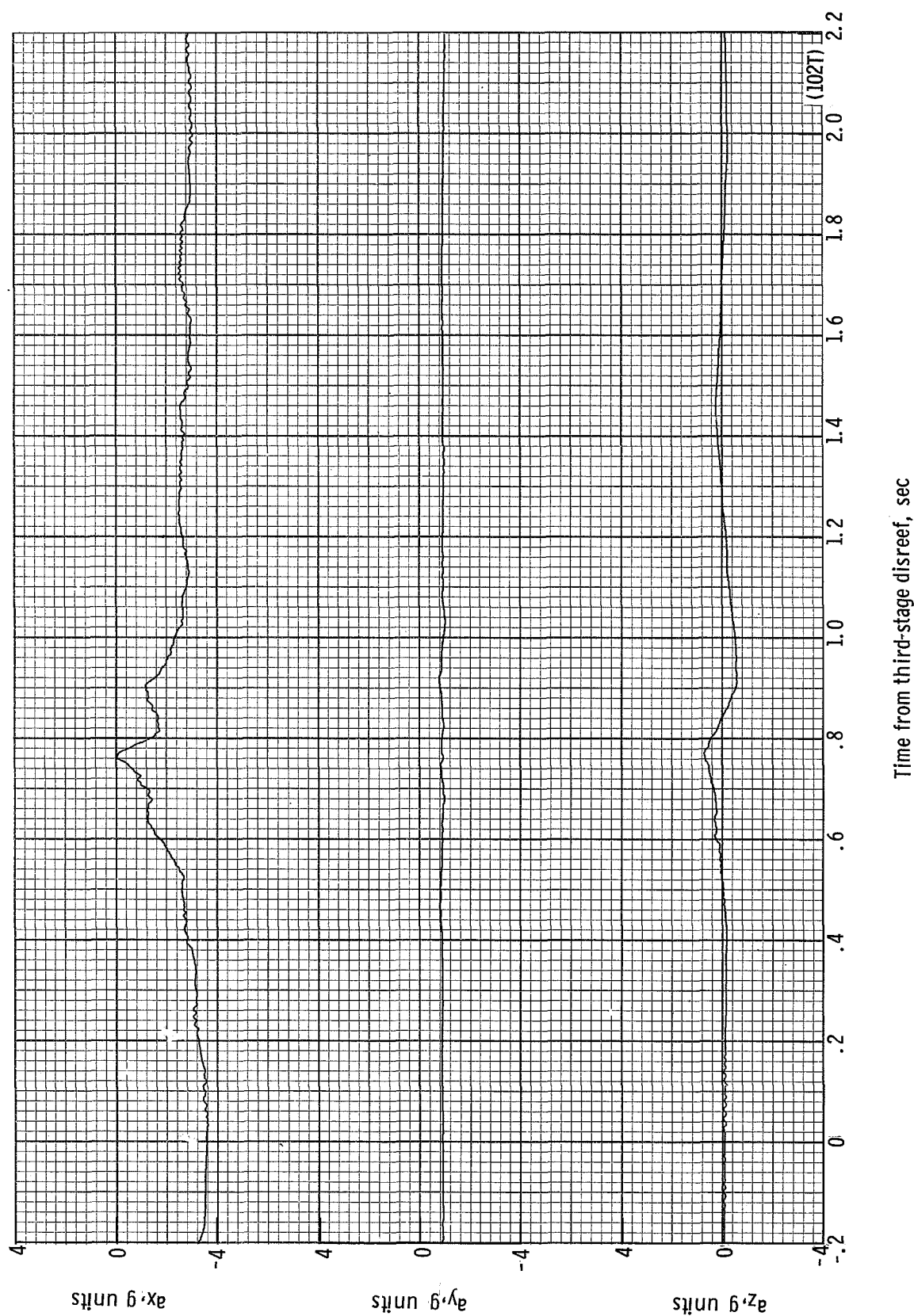
(p) Individual suspension-line loads F_{Lle1} , F_{Lle5} , F_{Lk1} , and F_{Lle6} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.36 seconds after launch.

Figure 24.- Continued.



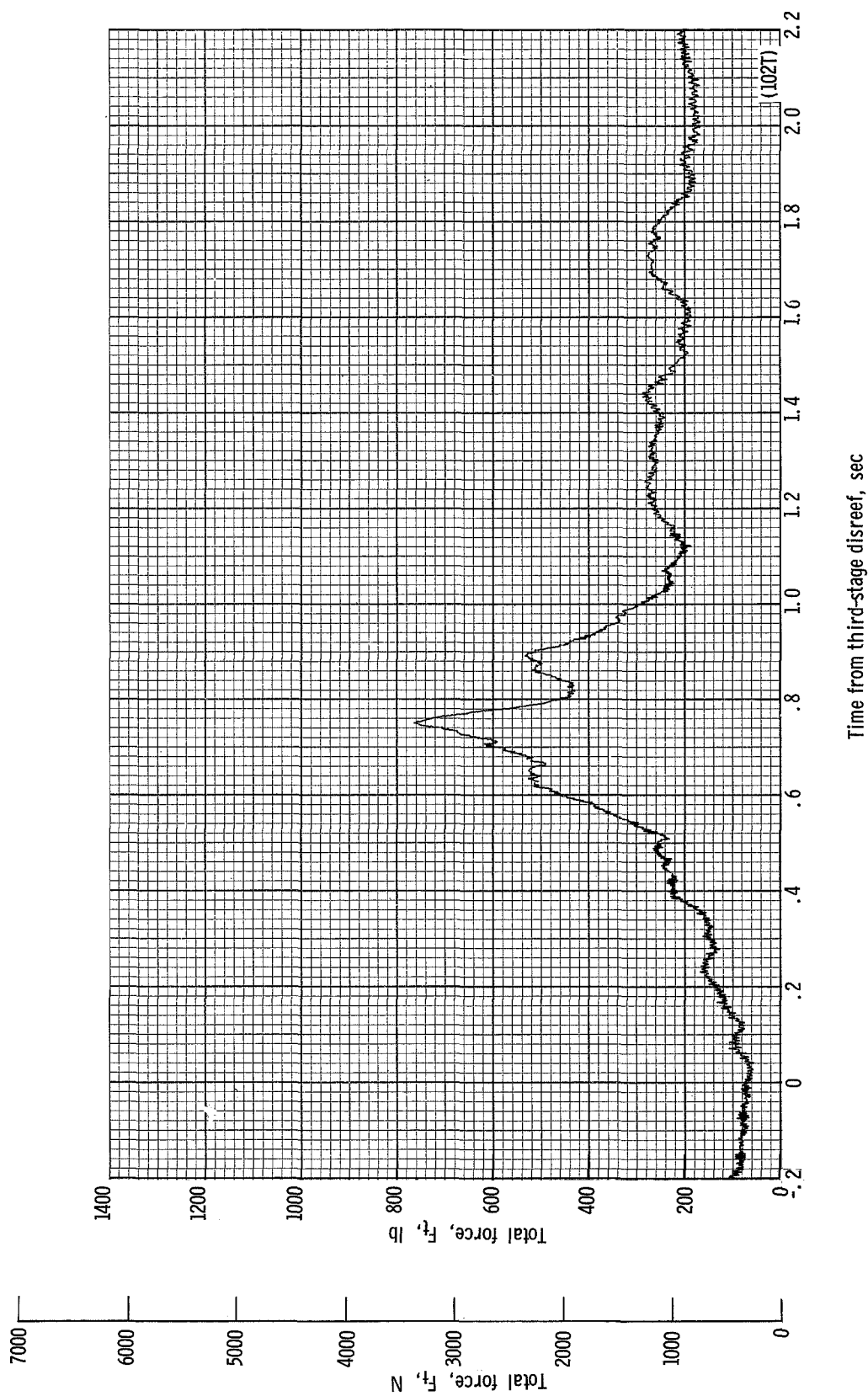
(q) Individual suspension-line loads FL_{k7} , FL_{k12} , and FL_{le3} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.36 seconds after launch.

Figure 24.- Continued.



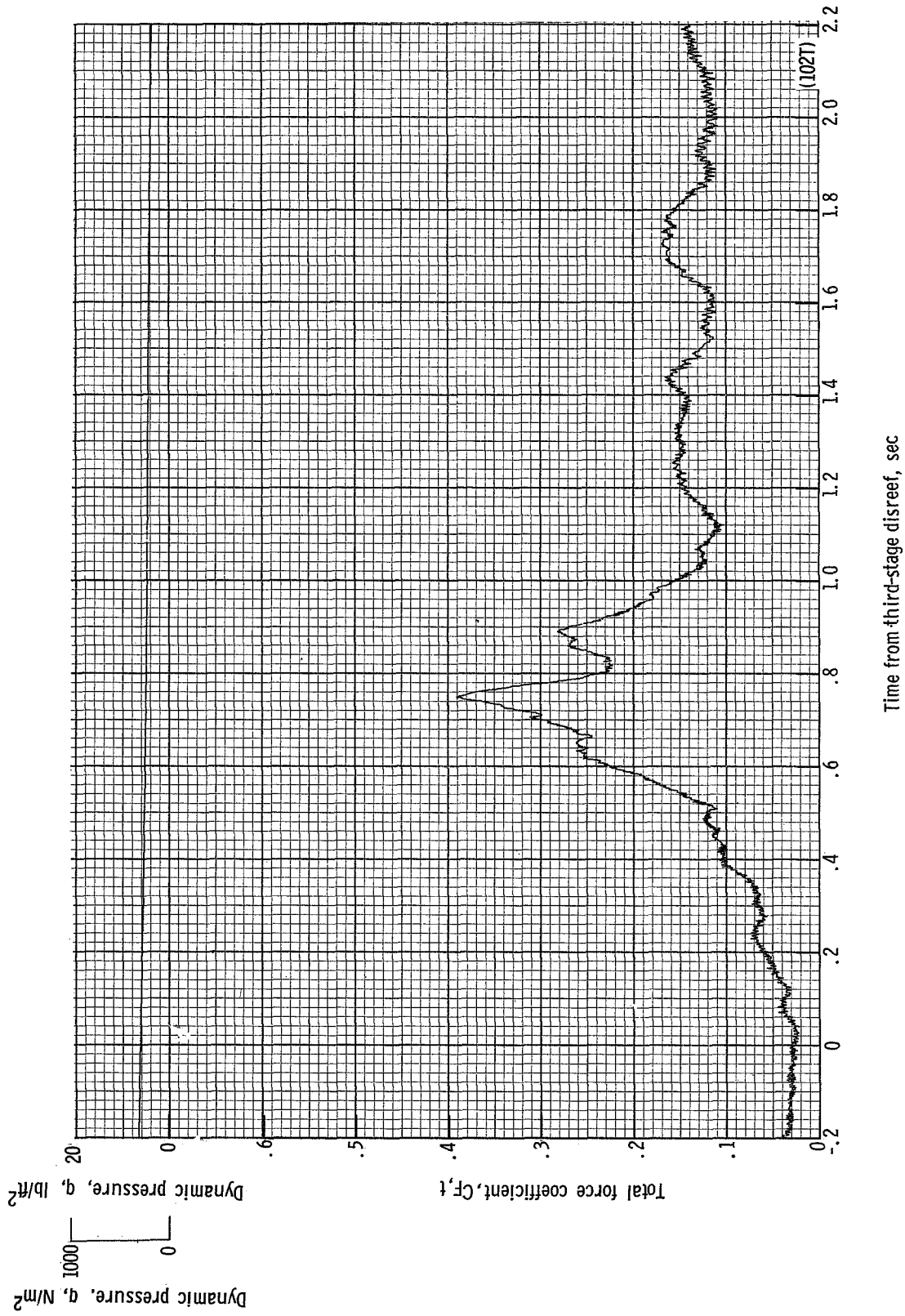
(r) Accelerations a_z , a_y , and a_x plotted against time from third-stage disreef. Time = 0 second corresponds to 36.36 seconds after launch.

Figure 24.- Continued.



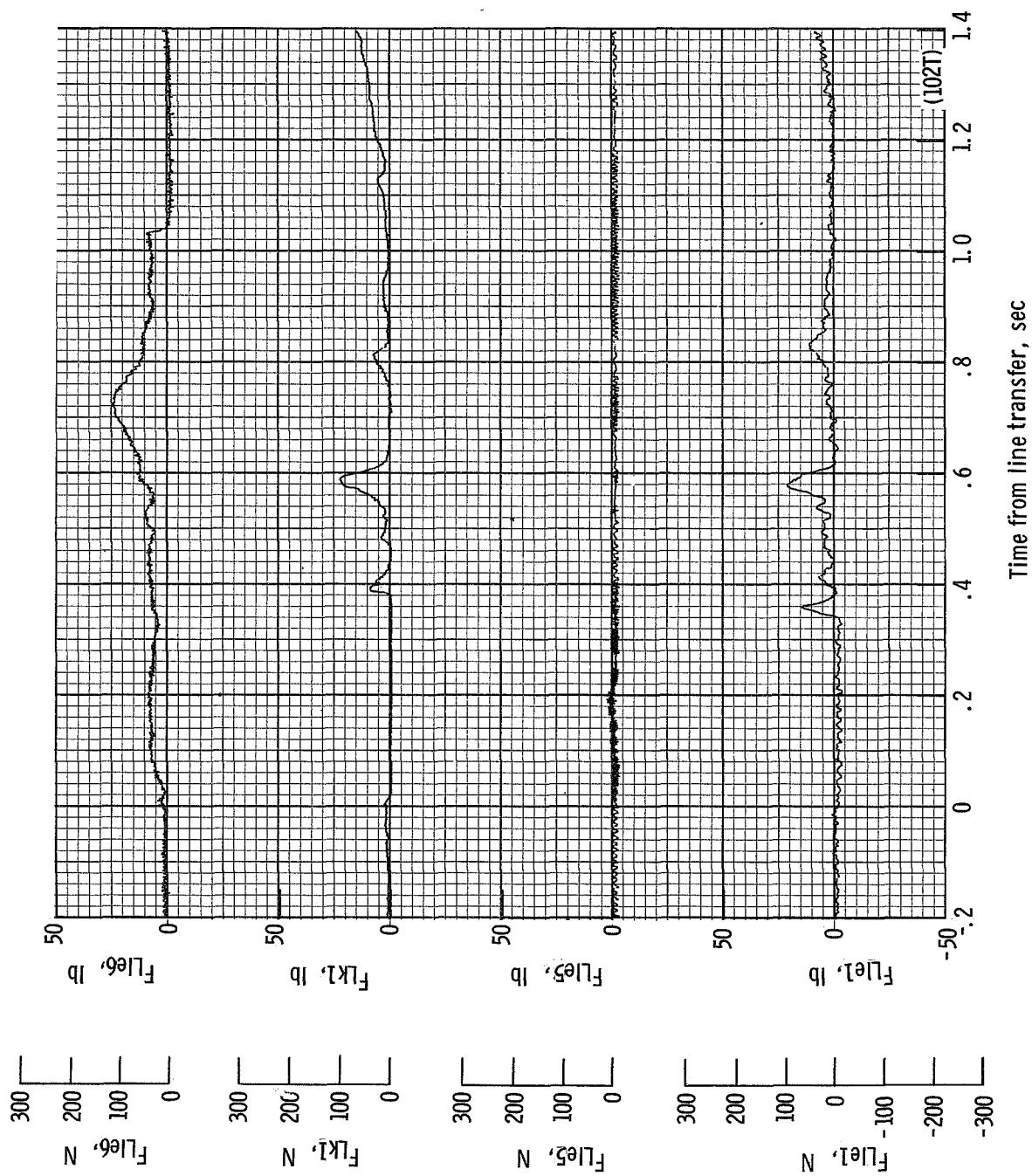
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.36 seconds after launch.

Figure 24.- Continued.



(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.36 seconds after launch.

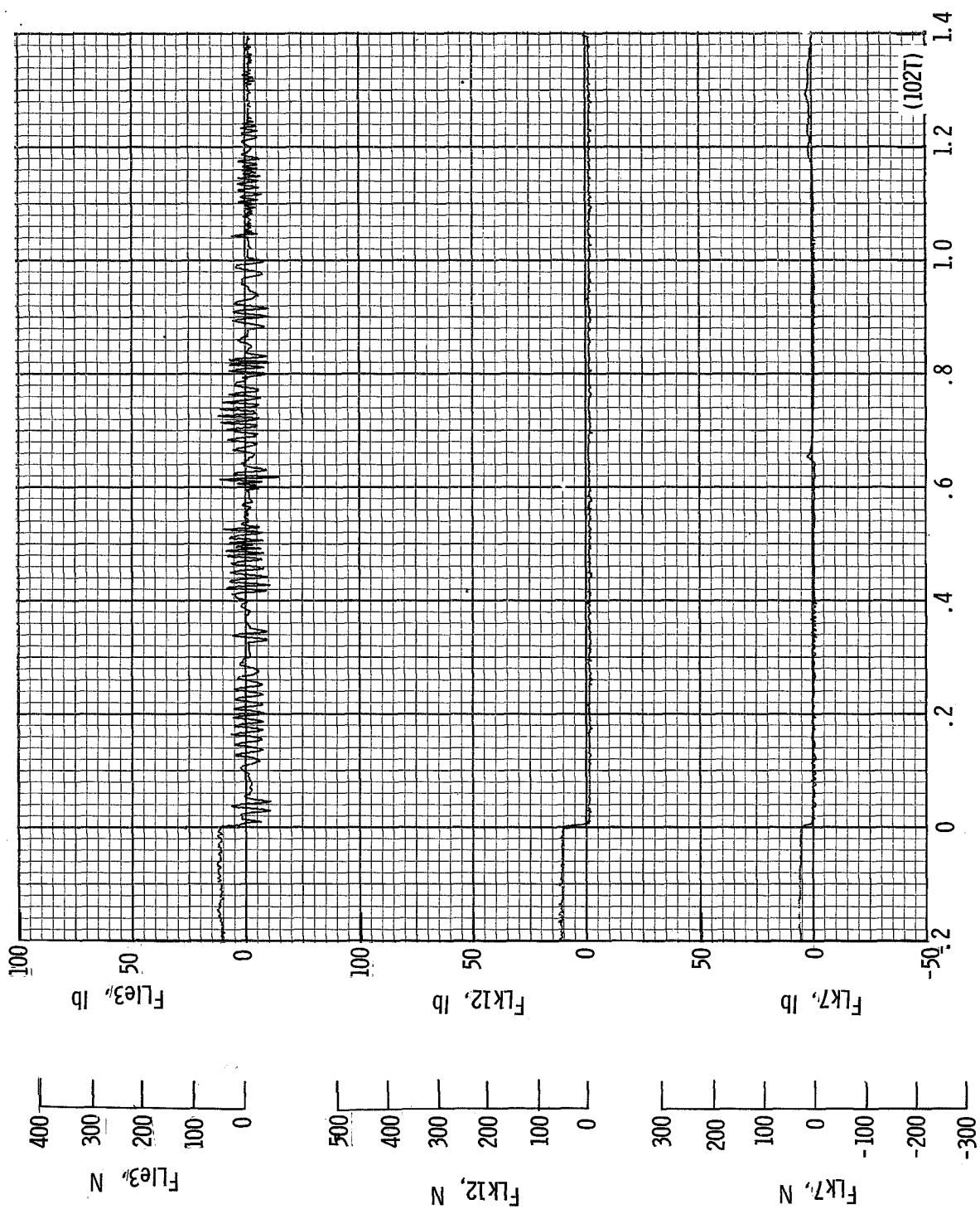
Figure 24.- Continued.



Time from line transfer, sec

(u) Individual suspension-line loads F_{Lle1} , F_{Lle5} , F_{Lk1} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 37.38 seconds after launch.

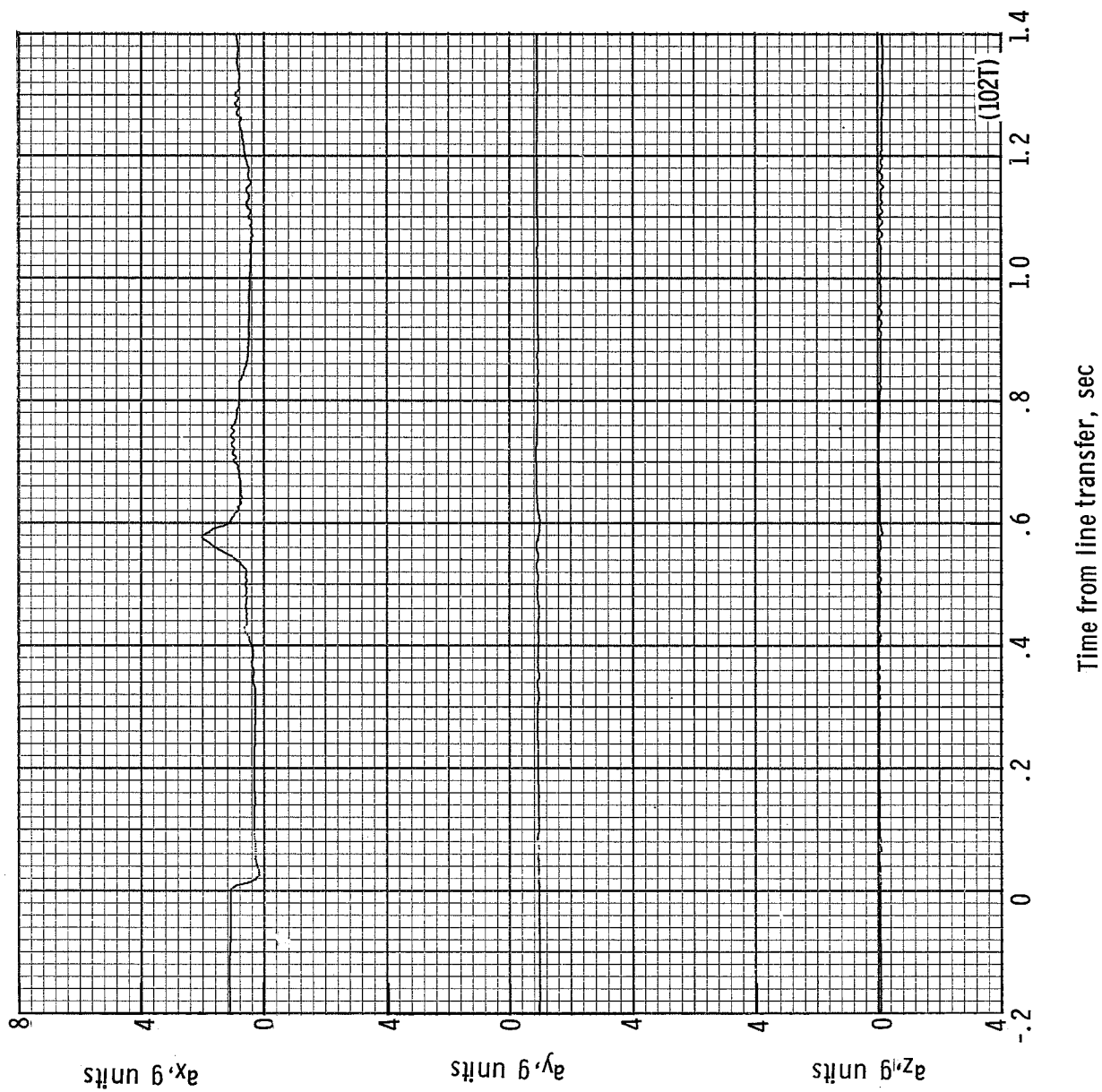
Figure 24.- Continued.



Time from line transfer, sec

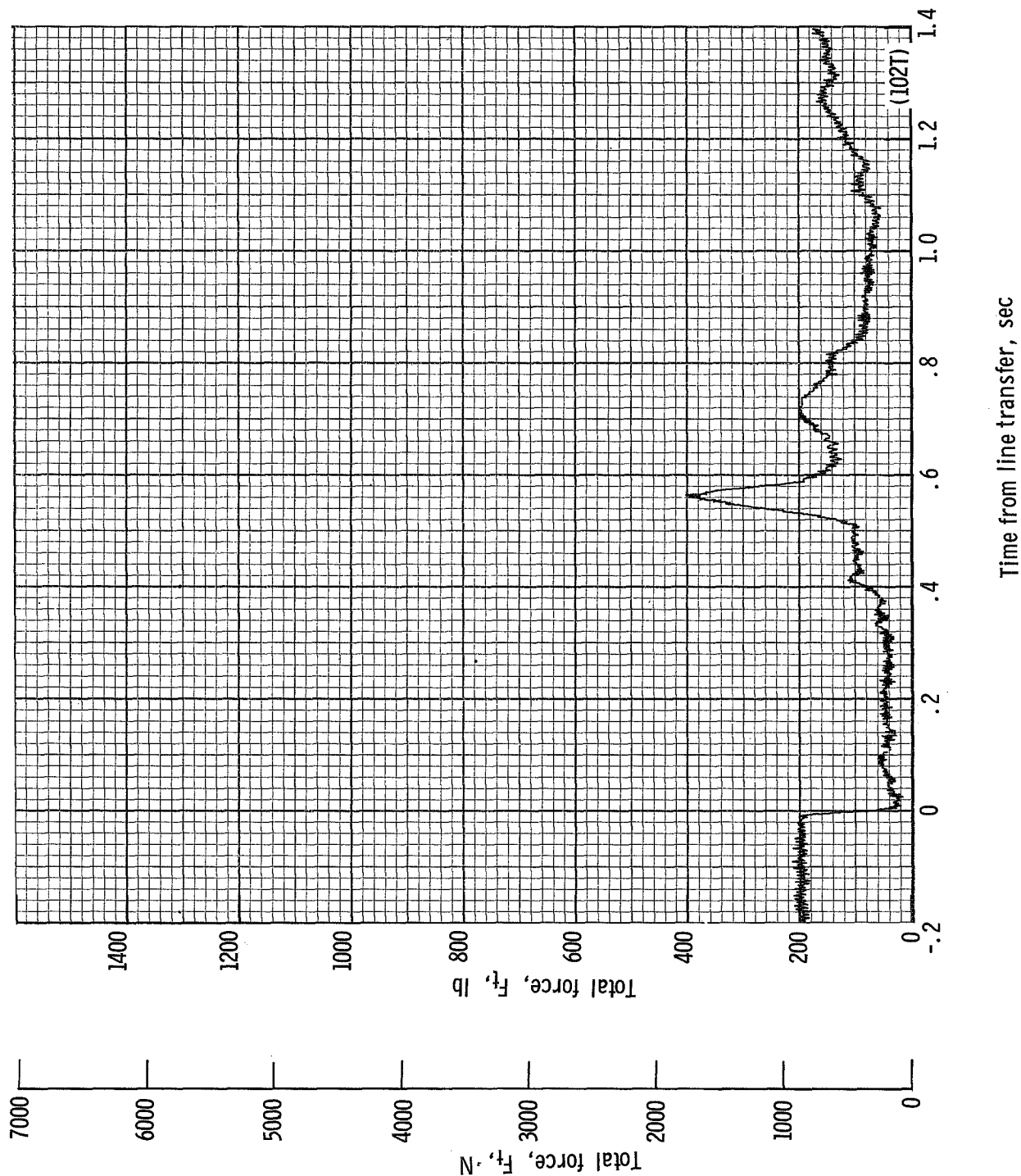
(v) Individual suspension-line loads $FLK7$, $FLK12$, and $FLIe3$ plotted against time from line transfer. Time = 0 second corresponds to 37.38 seconds after launch.

Figure 24.- Continued.



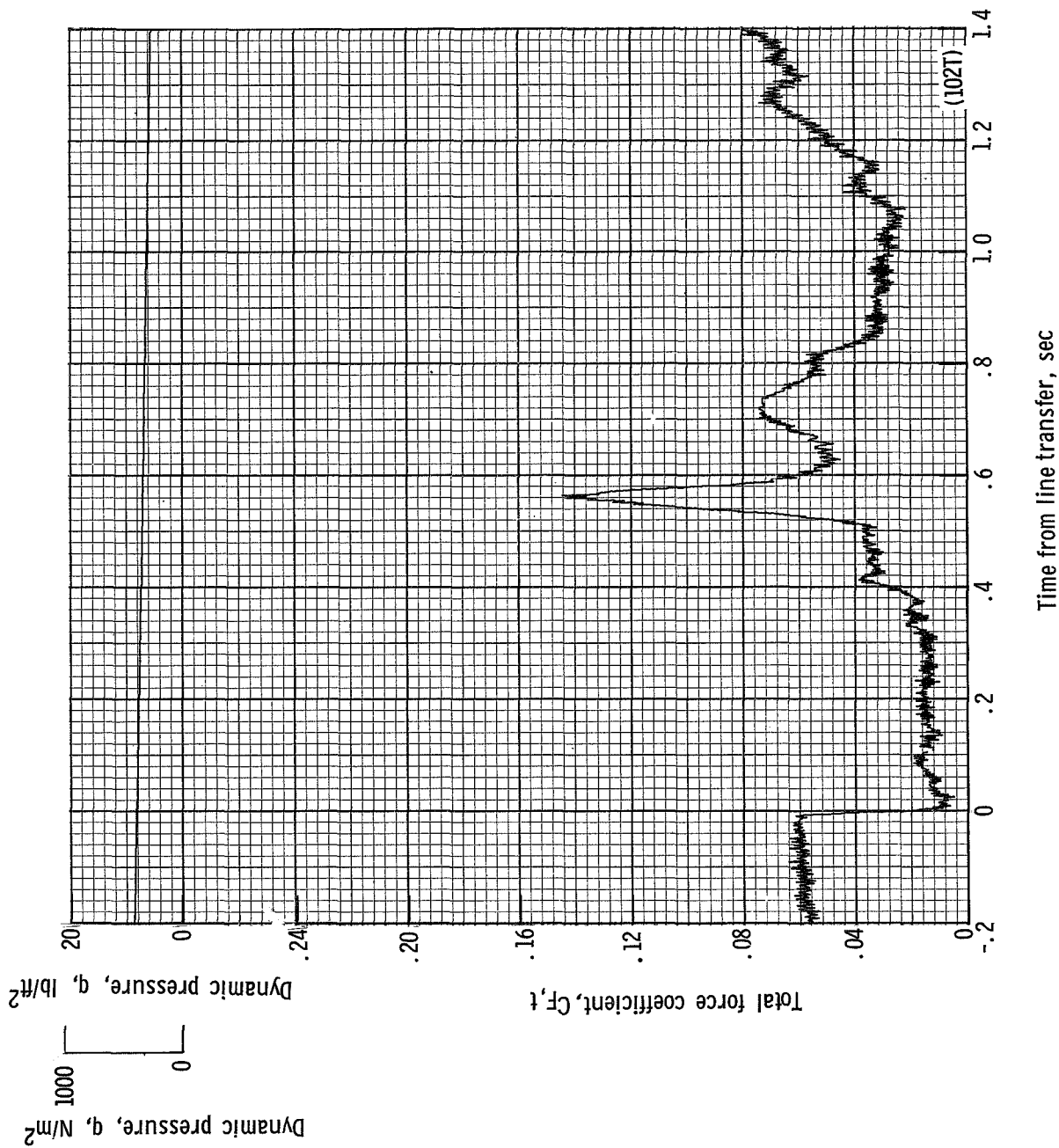
(w) Accelerations a_z , a_y , and a_x plotted against time from line transfer. Time = 0 second corresponds to 37.38 seconds after launch.

Figure 24.- Continued.



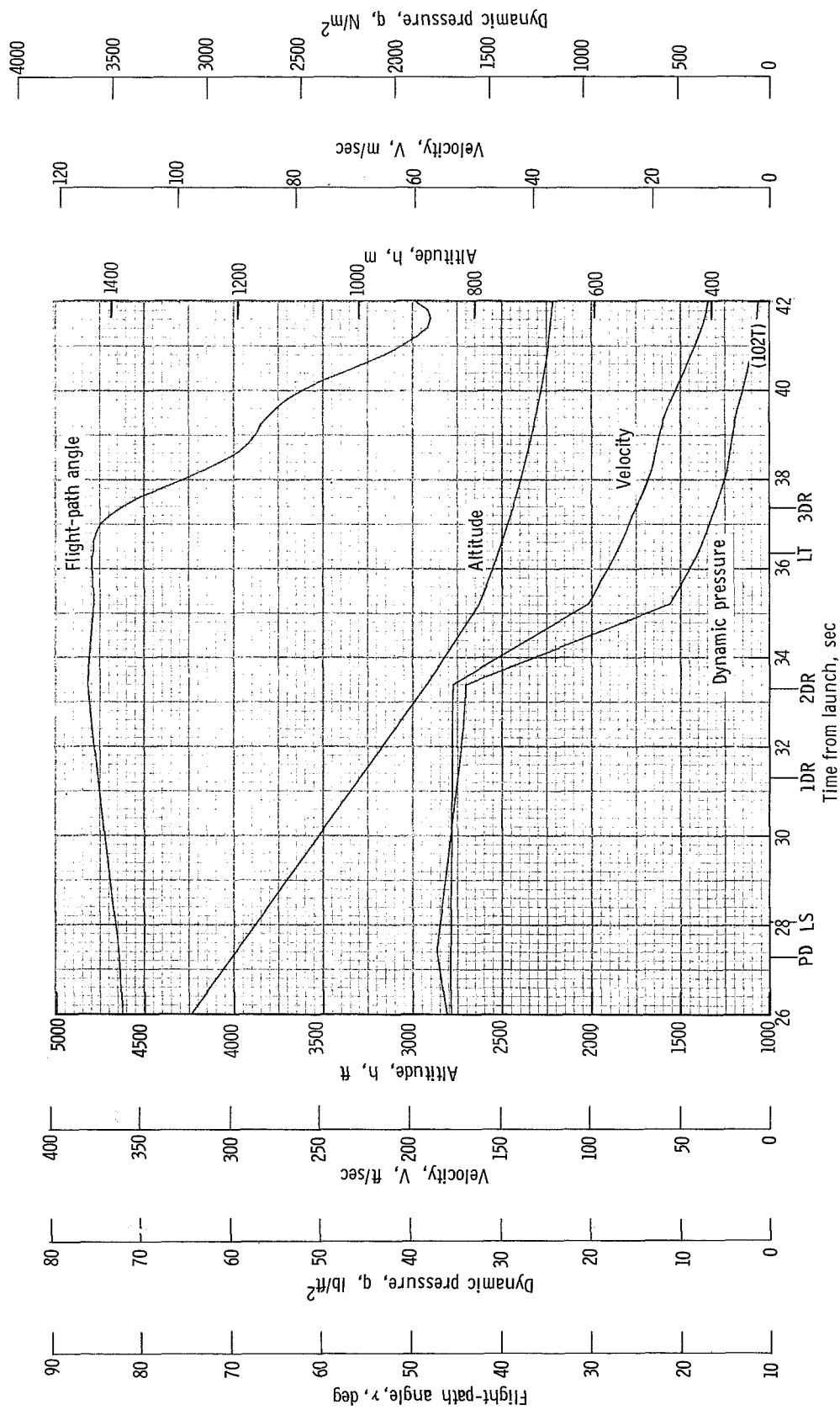
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 37.38 seconds after launch.

Figure 24.- Continued.



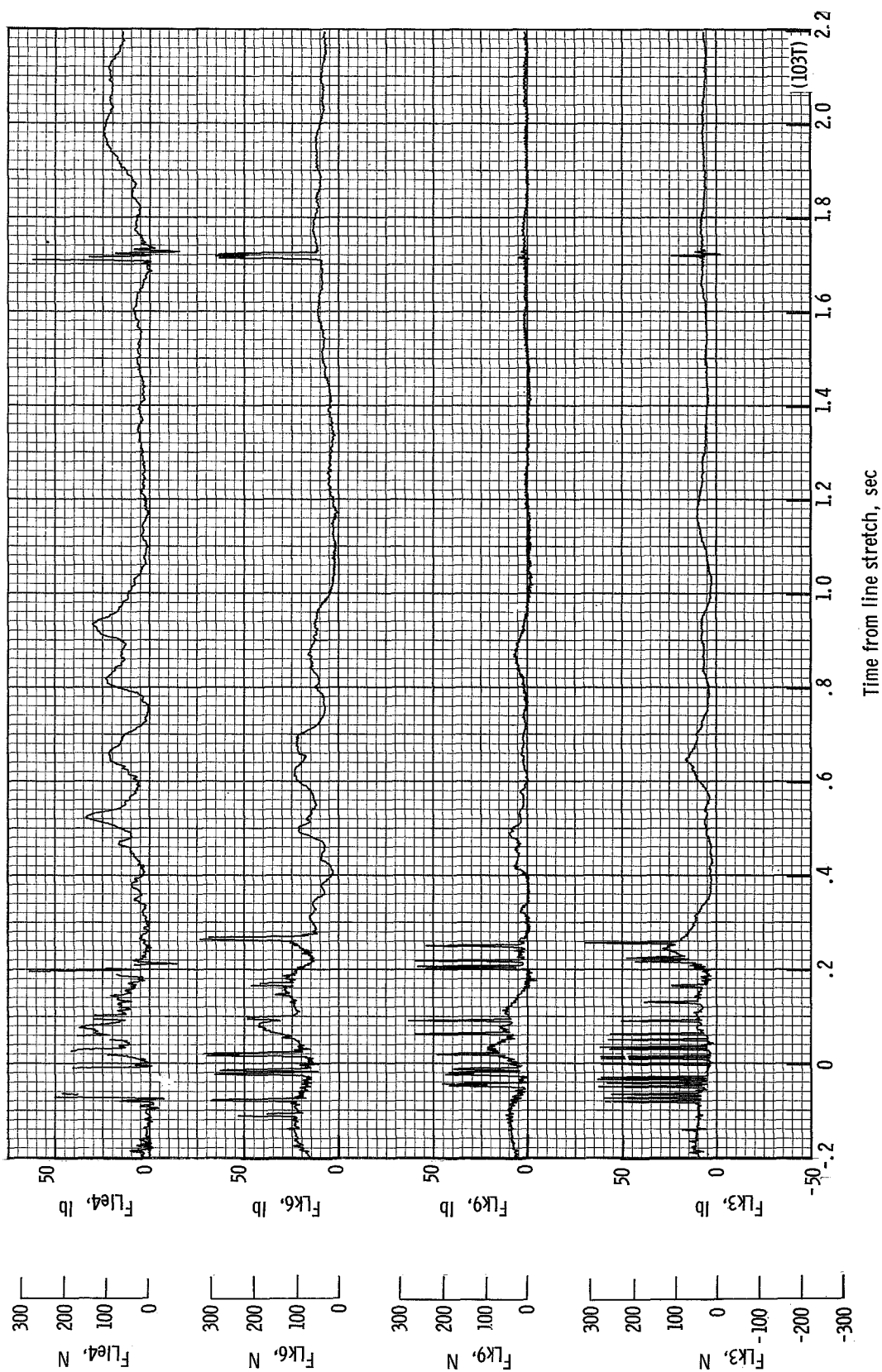
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 37.38 seconds after launch.

Figure 24.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

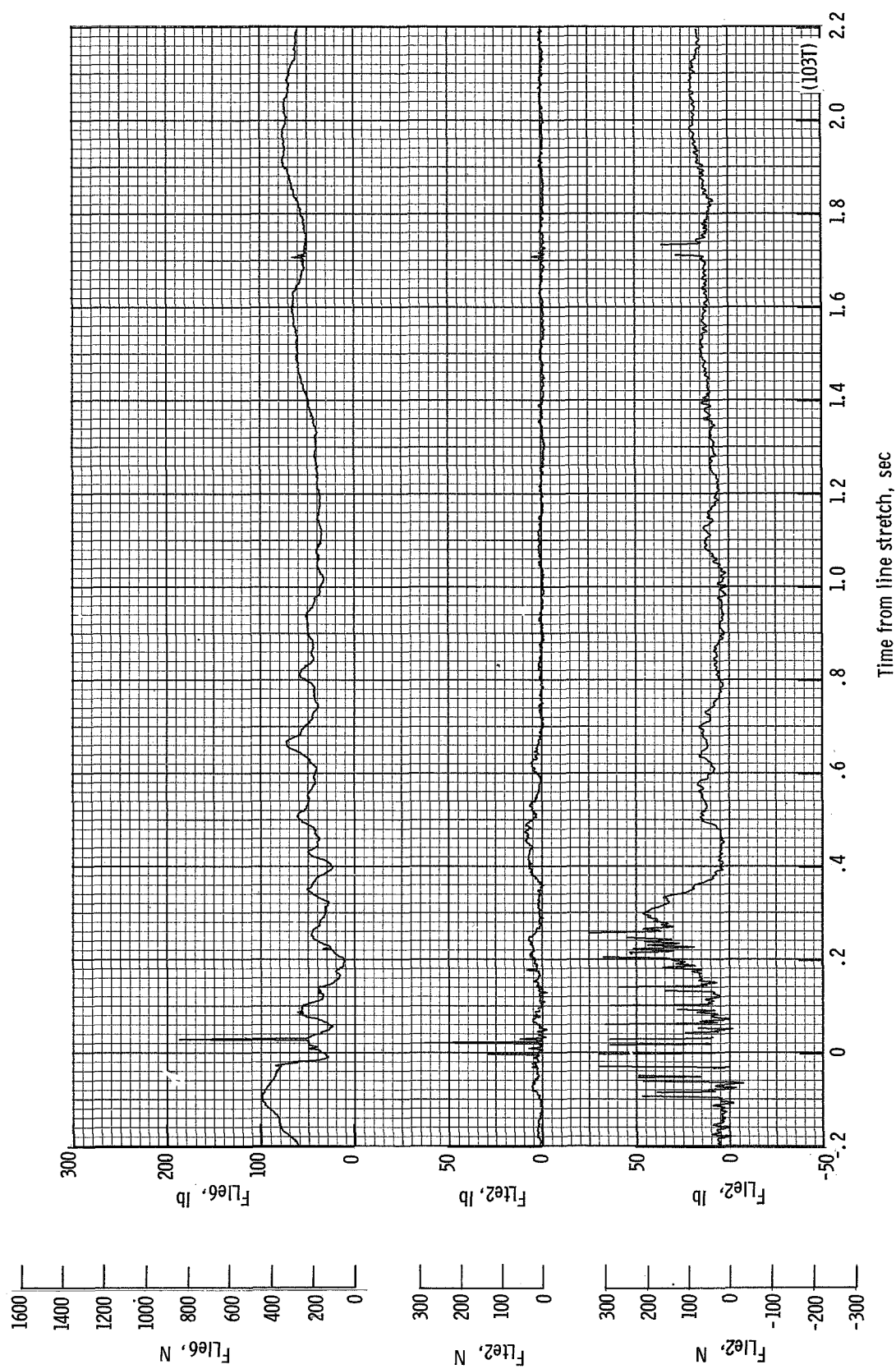
Figure 24.- Concluded.



(a) Individual suspension-line loads F_{LK3} , F_{LK9} , F_{LK6} , and F_{LK4} plotted against time from line stretch. Time = 0 second corresponds to 24.85 seconds after launch.

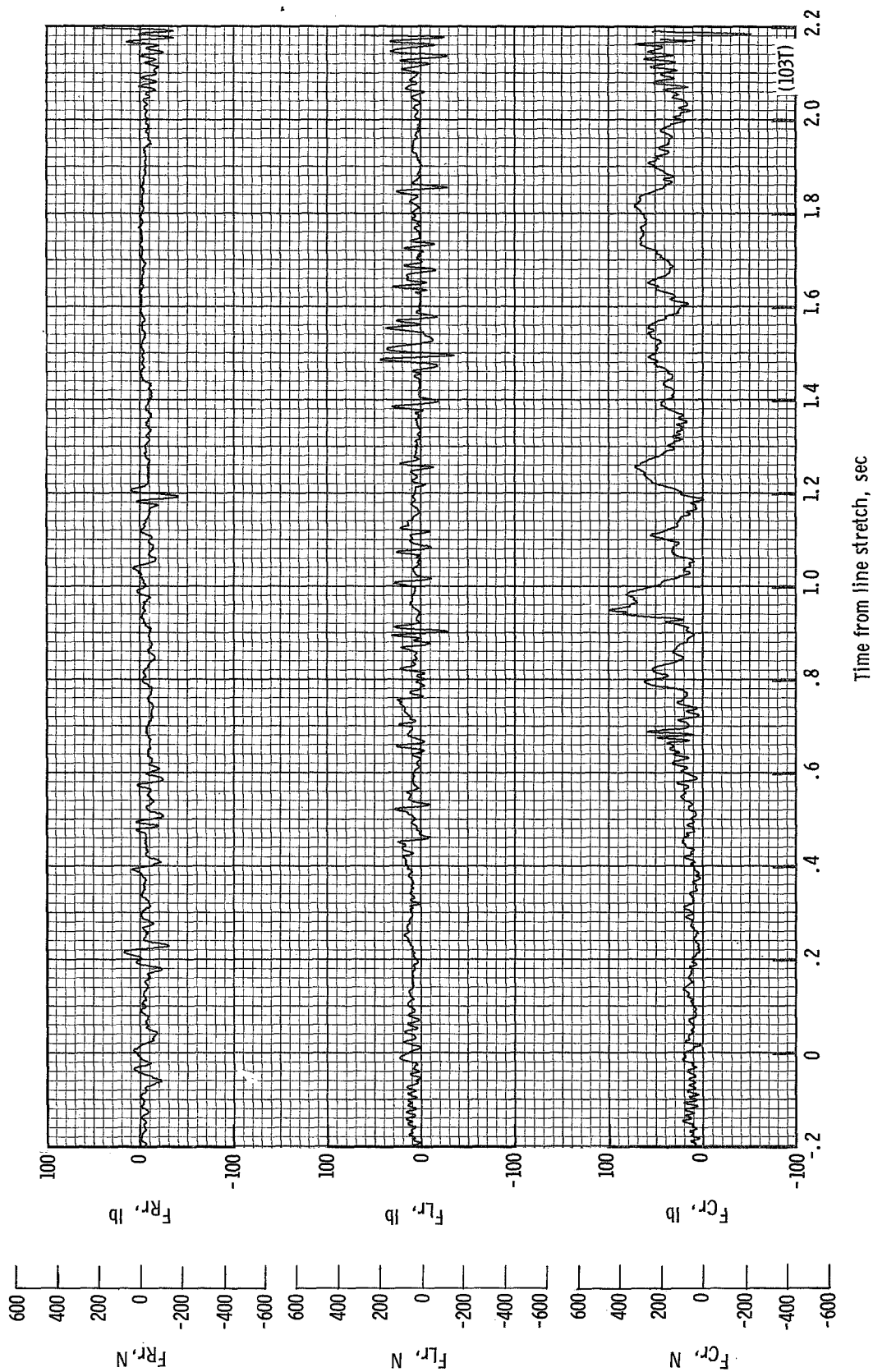
Figure 25.- Time history of twin-keel parawing deployment data for test 103T. $W_D = 1129.9$ N (254.0 lb); $W_P = 976.6$ N (219.6 lb); $q_{PD} = 2183.3$ N/m² (45.6 lb/ft²).

$h_{PD} = 997.0$ m (3272 ft); $t_r/t_k = 0.167$; reefing version 1.



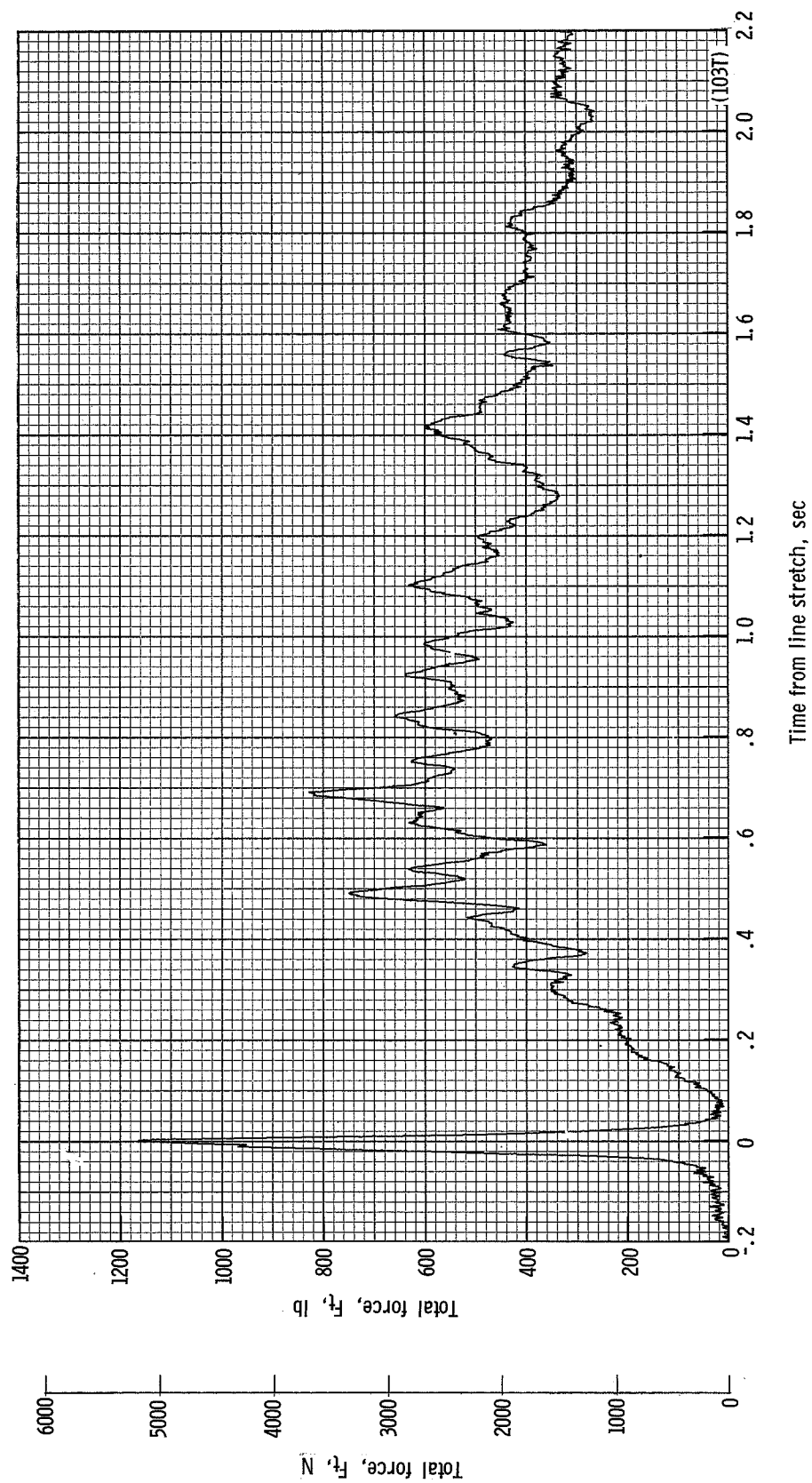
(b) Individual suspension-line loads F_{Lie2} , F_{Lie6} and F_{Lte2} plotted against time from line stretch. Time = 0 second corresponds to 24.85 seconds after launch.

Figure 25.- Continued.



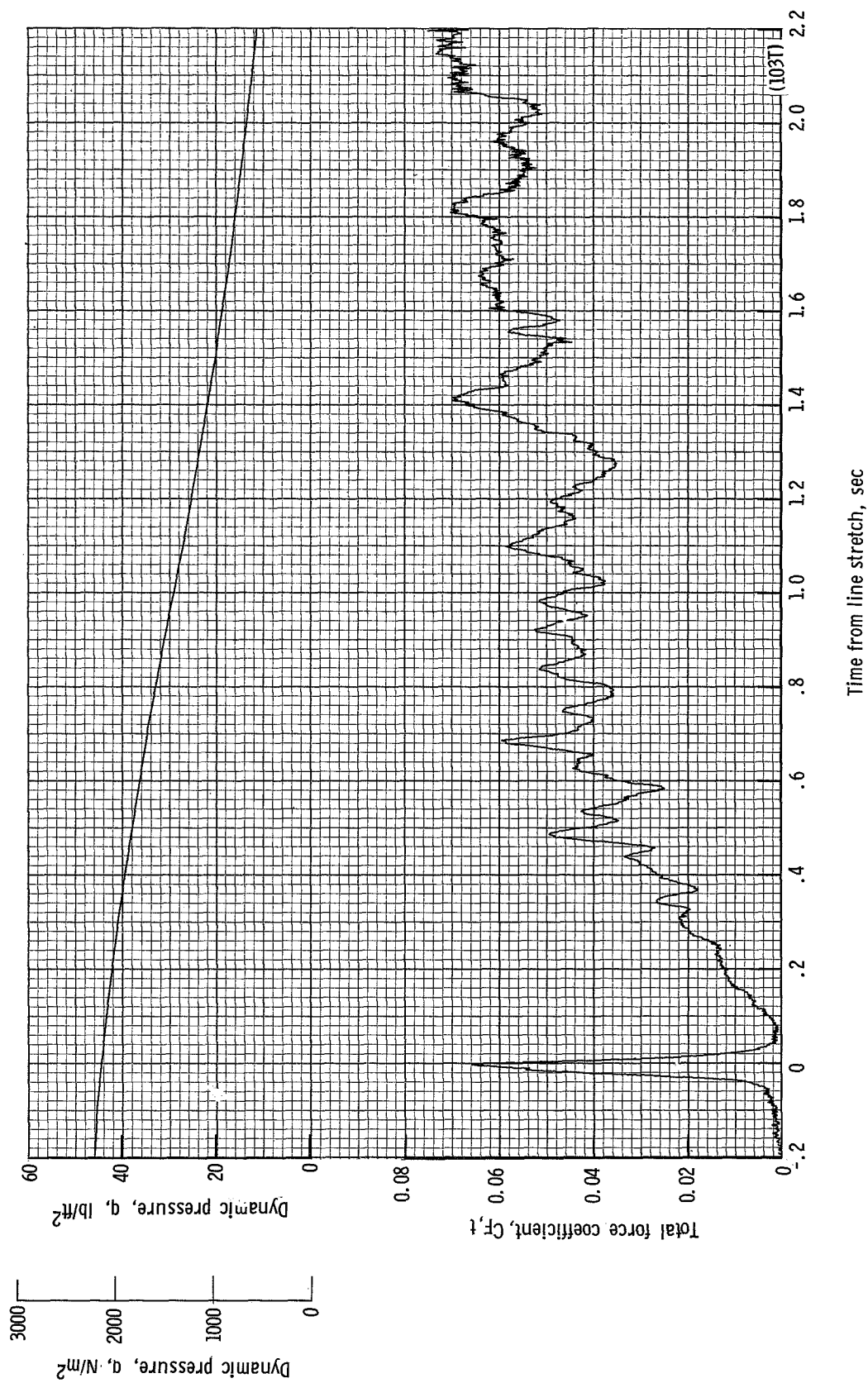
(c) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rr} plotted against time from line stretch. Time = 0 second corresponds to 24.85 seconds after launch.

Figure 25.- Continued.



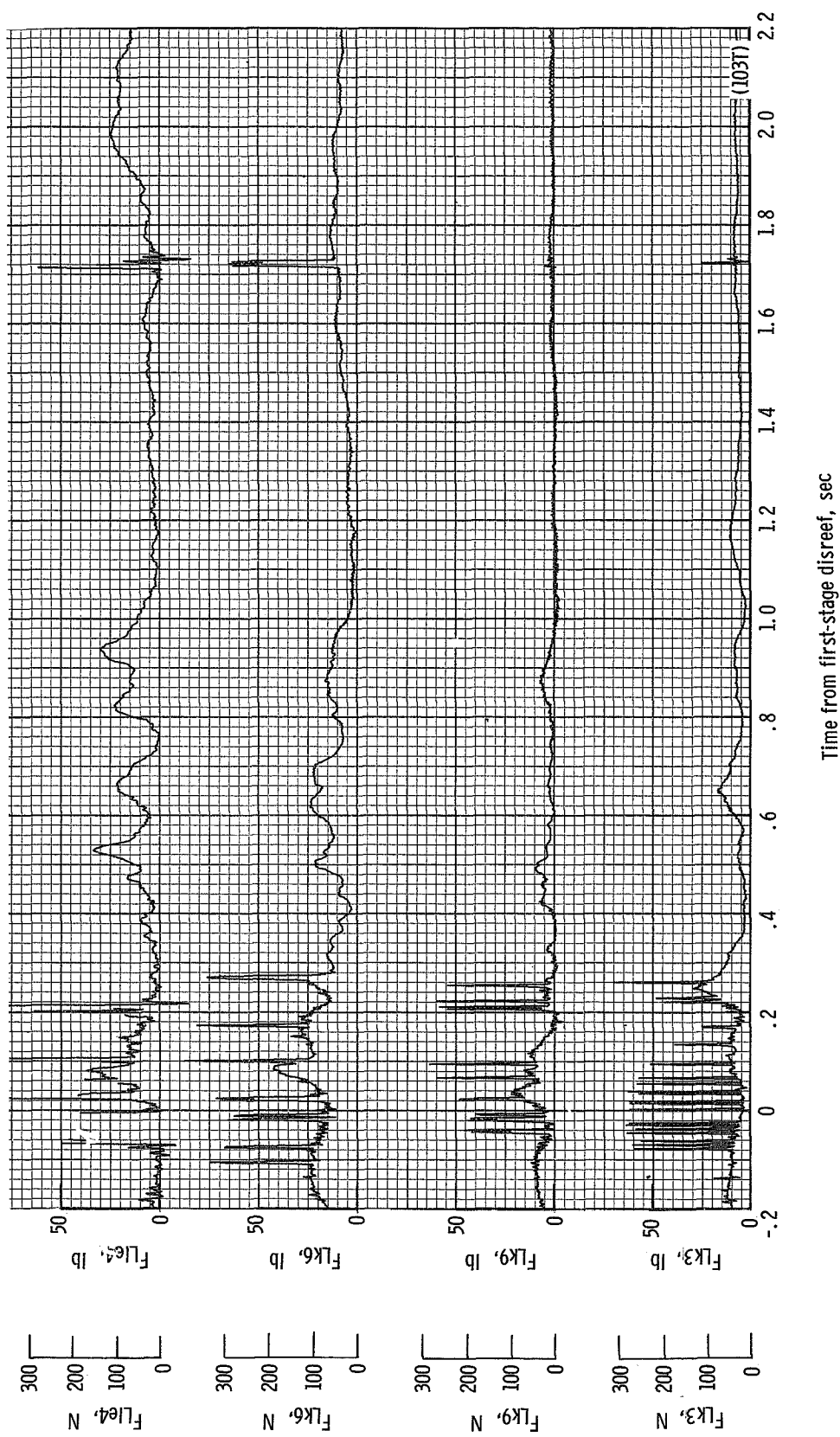
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 24.85 seconds after launch.

Figure 25.- Continued.



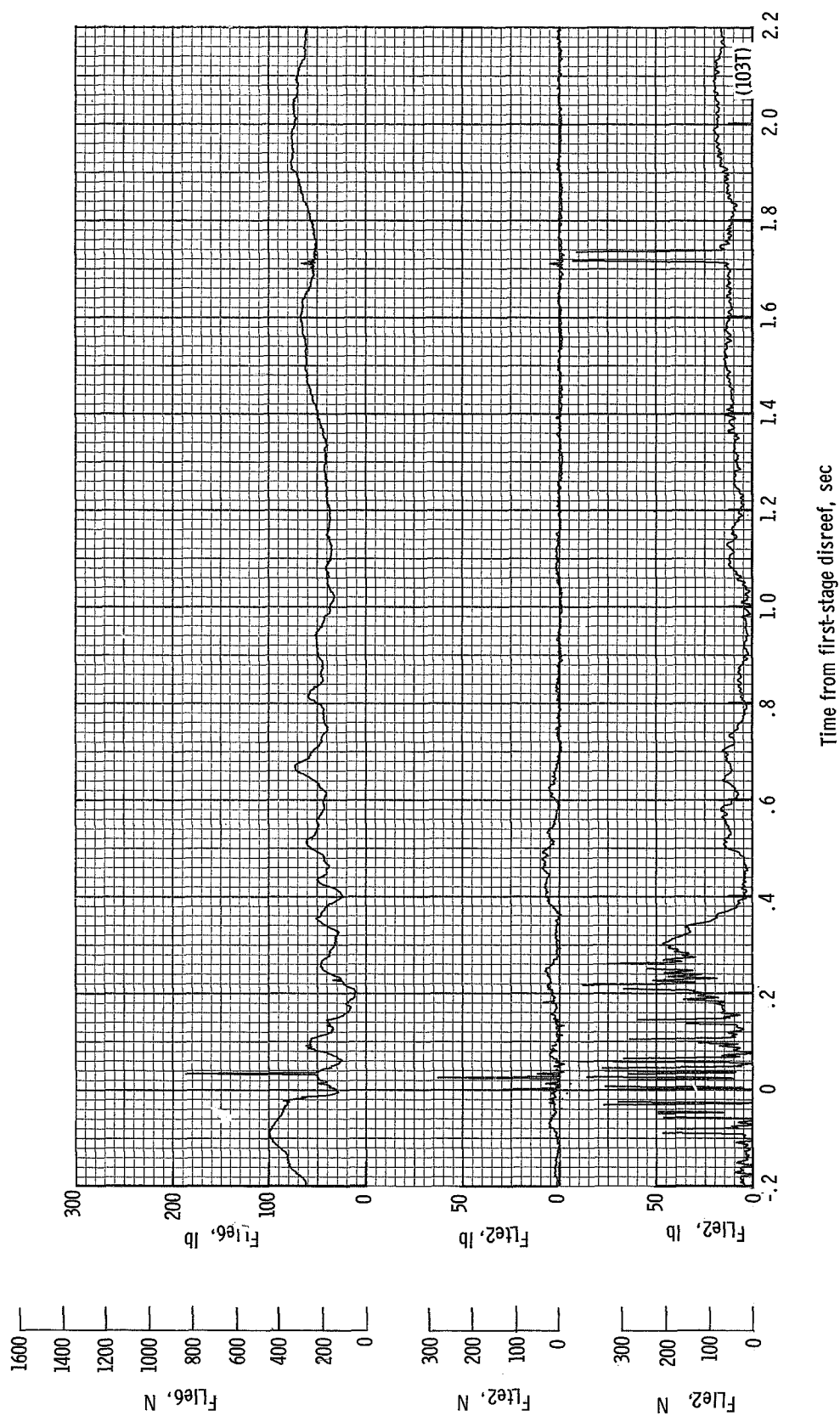
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 24.85 seconds after launch.

Figure 25.- Continued.



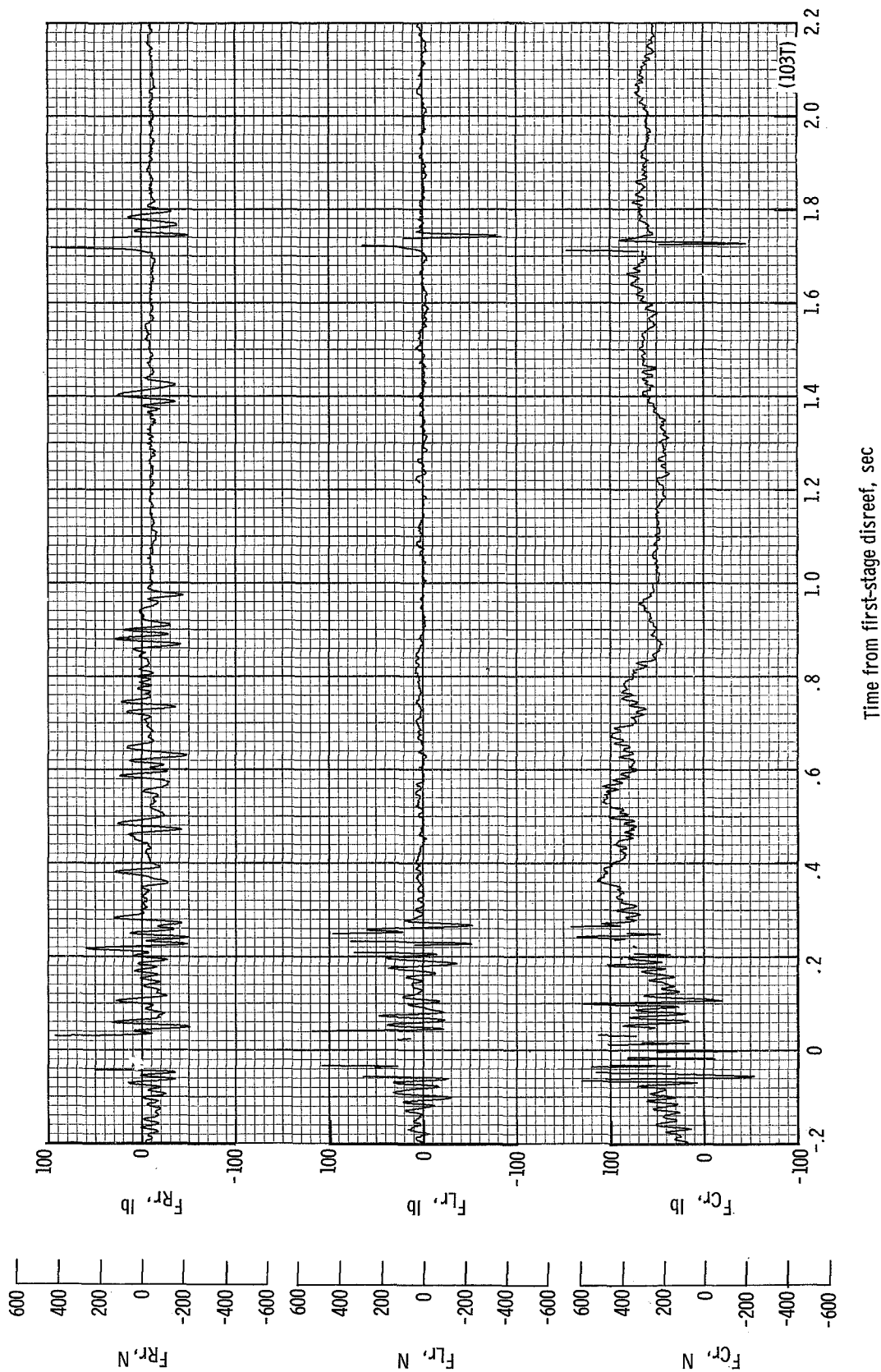
(f) Individual suspension-line loads $FLK3$, $FLK9$, $FLK6$ and $FLie4$ plotted against time from first-stage disreef. Time = 0 second corresponds to 27.09 seconds after launch.

Figure 25.- Continued.



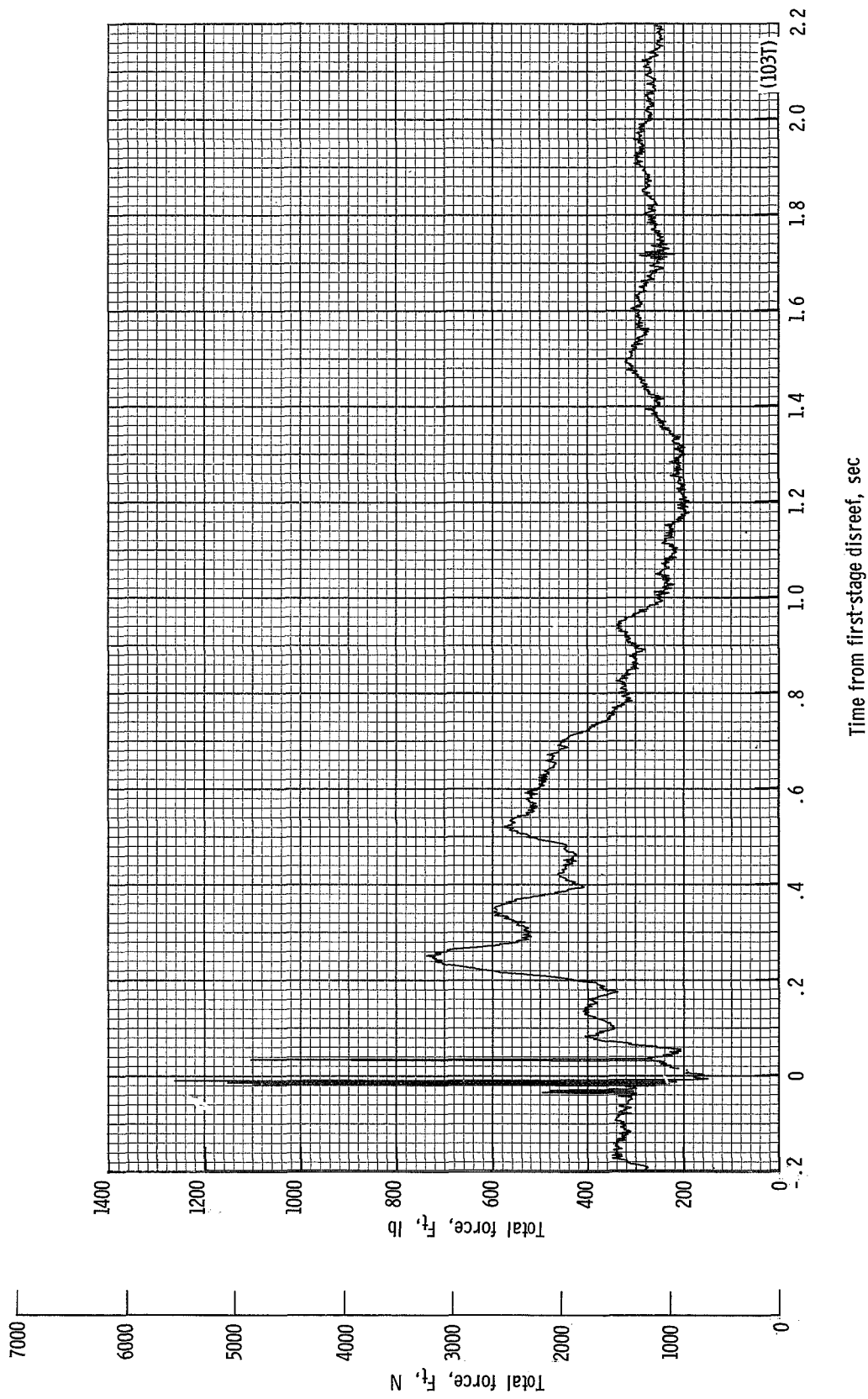
(g) Individual suspension-line loads F_{Lie2} , F_{Lie2} , and F_{Lie6} plotted against time from first-stage disreef. Time = 0 second corresponds to 27.09 seconds after launch.

Figure 25.- Continued.



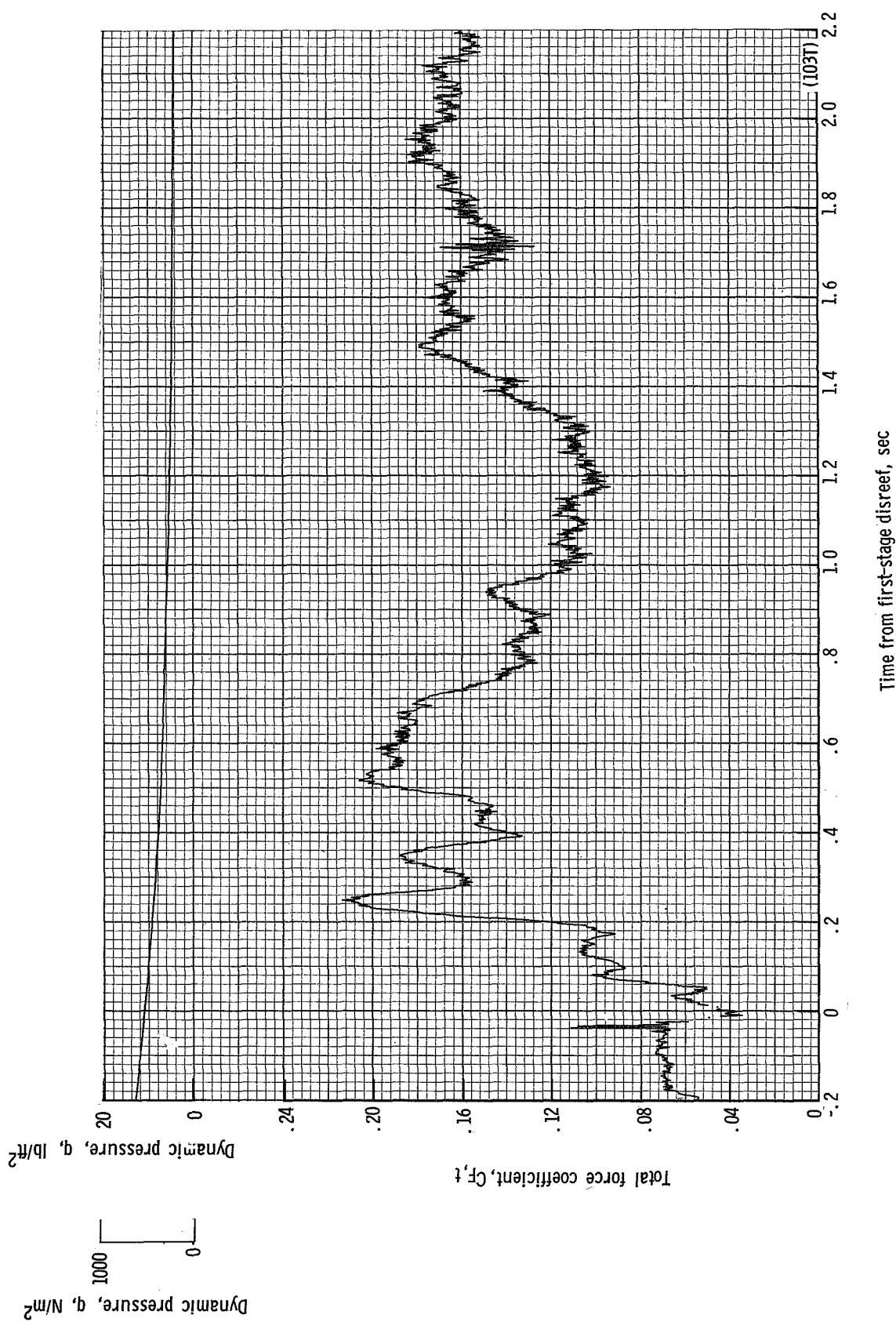
(h) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rr} plotted against time from first-stage disreef. Time = 0 second corresponds to 27.09 seconds after launch.

Figure 25.- Continued.



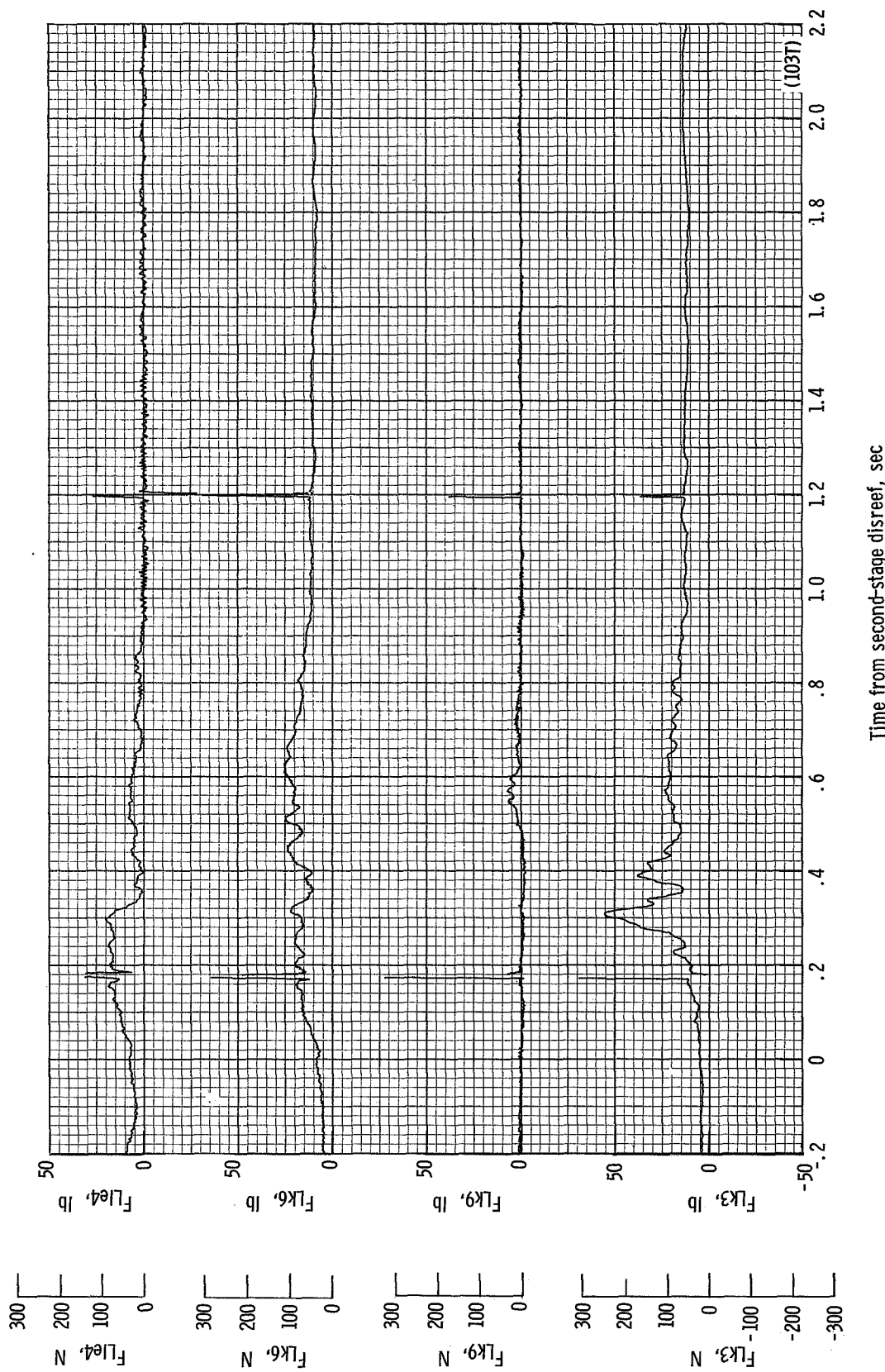
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 27.09 seconds after launch.

Figure 25:- Continued.



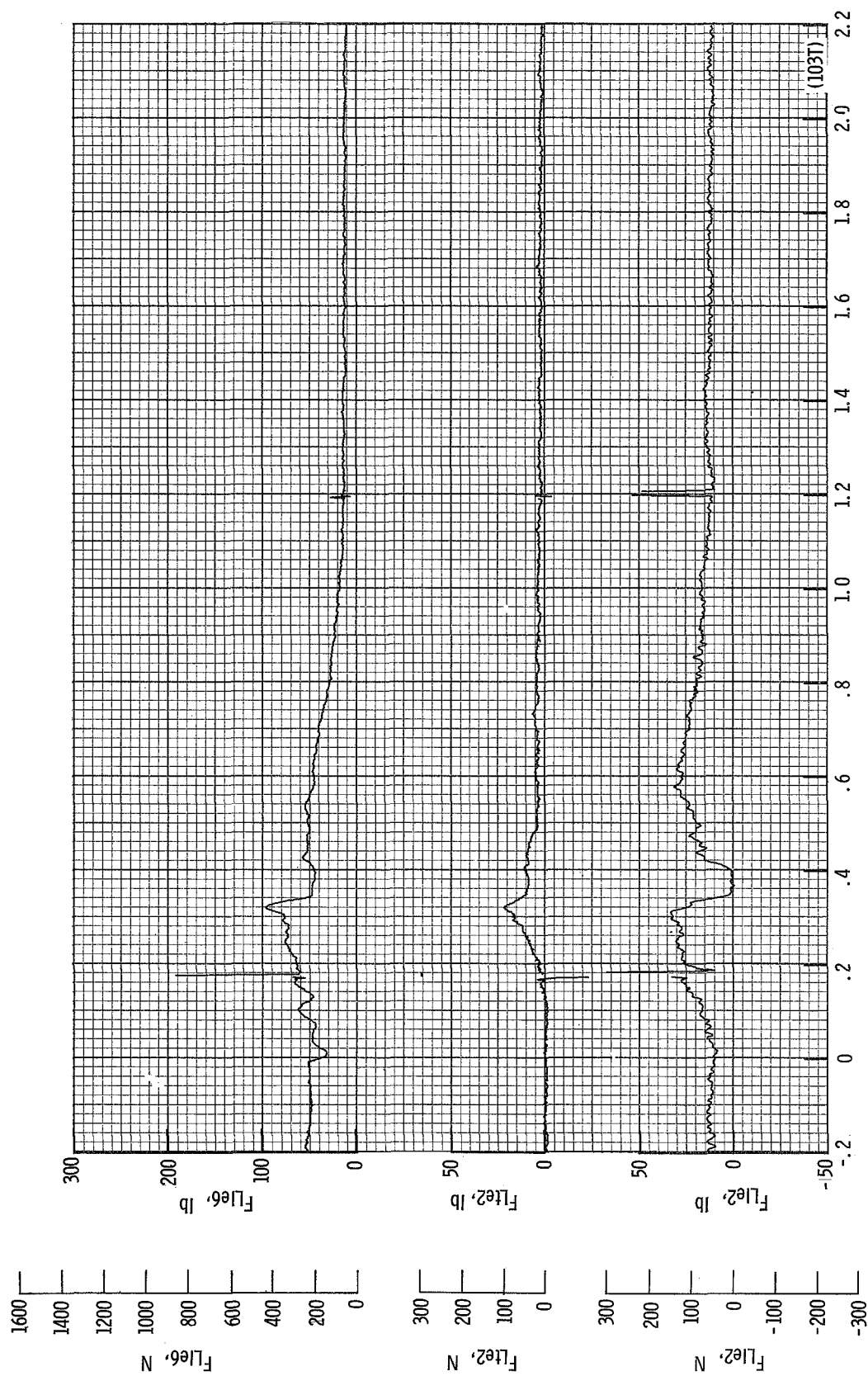
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 27.09 seconds after launch.

Figure 25.- Continued.



(k) Individual suspension-line loads F_{LK3} , F_{LK9} , F_{LK6} and F_{LK4} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.51 seconds after launch.

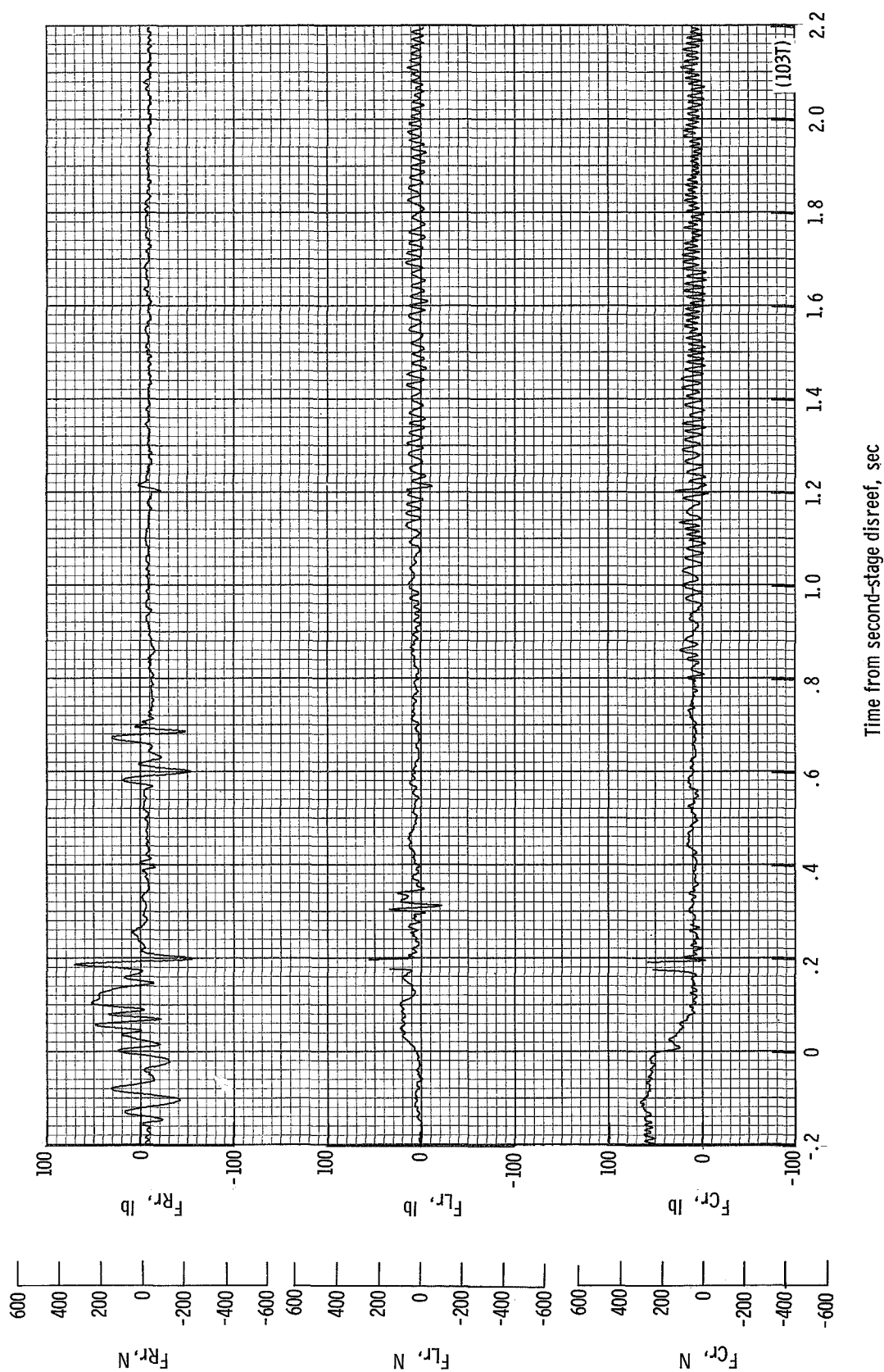
Figure 25.- Continued.



Time from second-stage disreef, sec

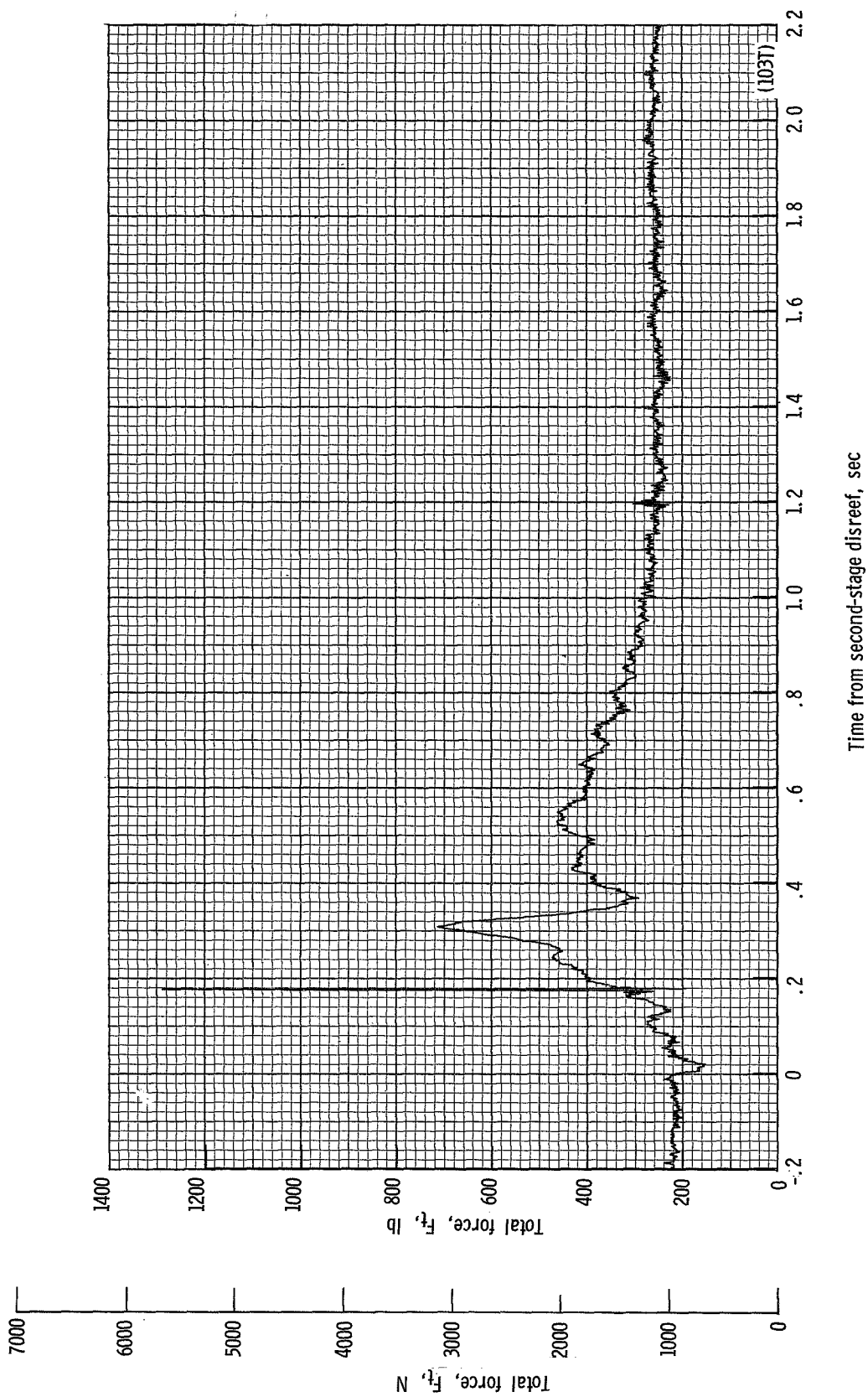
(1) Individual suspension-line loads F_{Lle2} , F_{Lle2} , and F_{Lle6} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.51 seconds after launch.

Figure 25.- Continued.



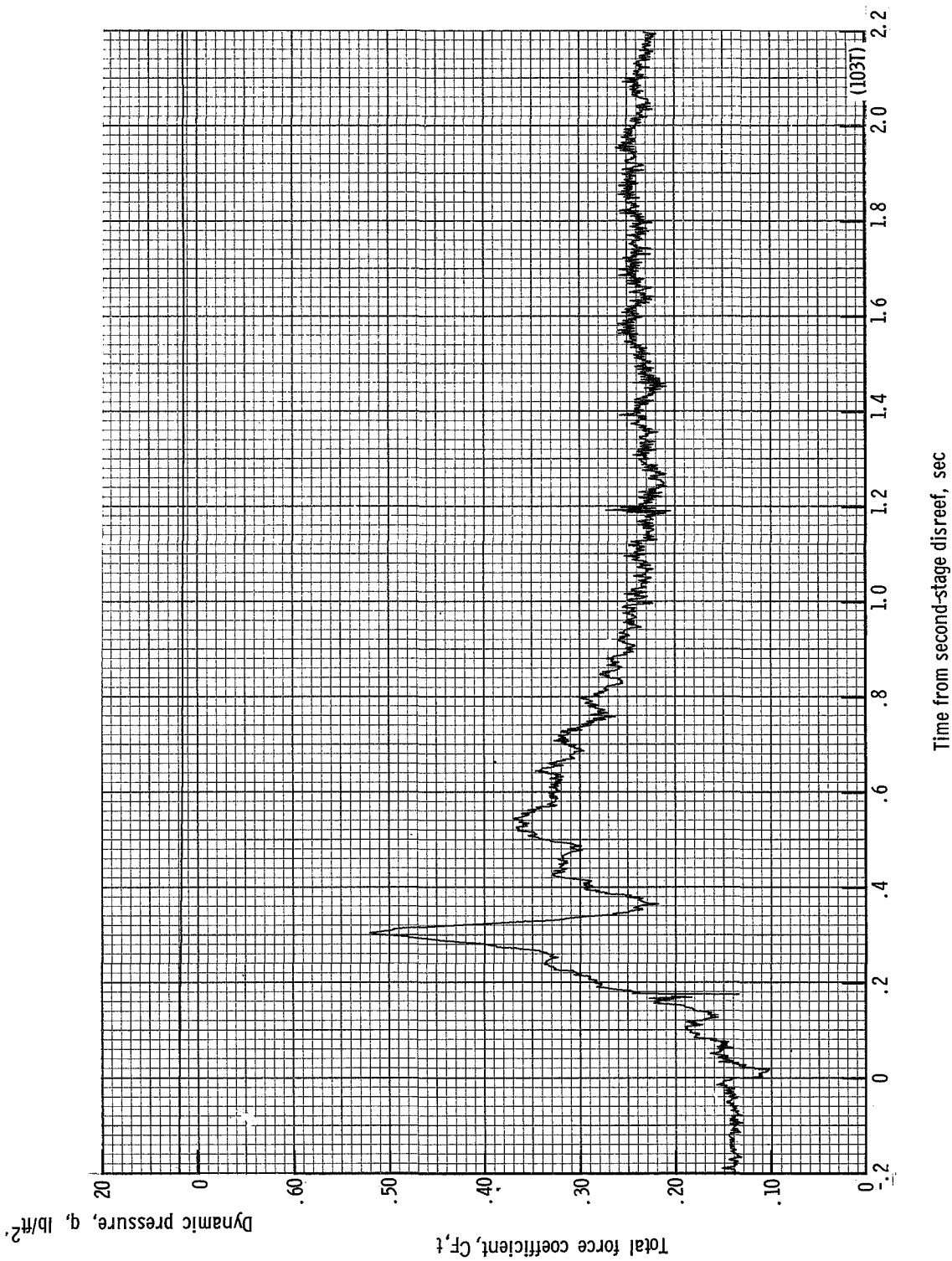
(m) Individual reefing-line load F_{CR} , F_{LR} , and F_{RR} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.51 seconds after launch.

Figure 25.- Continued.



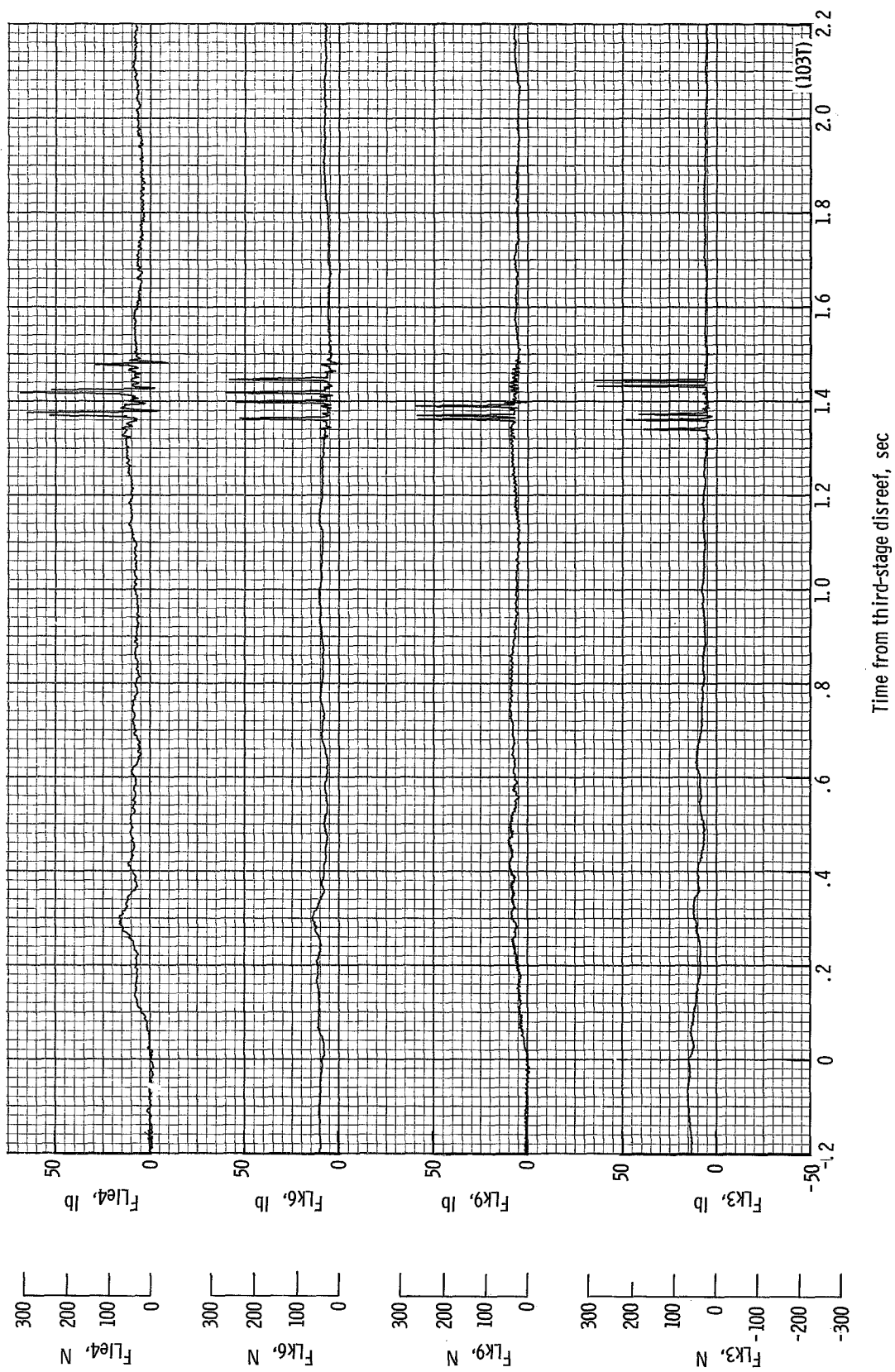
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 30.51 seconds after launch.

Figure 25.- Continued.



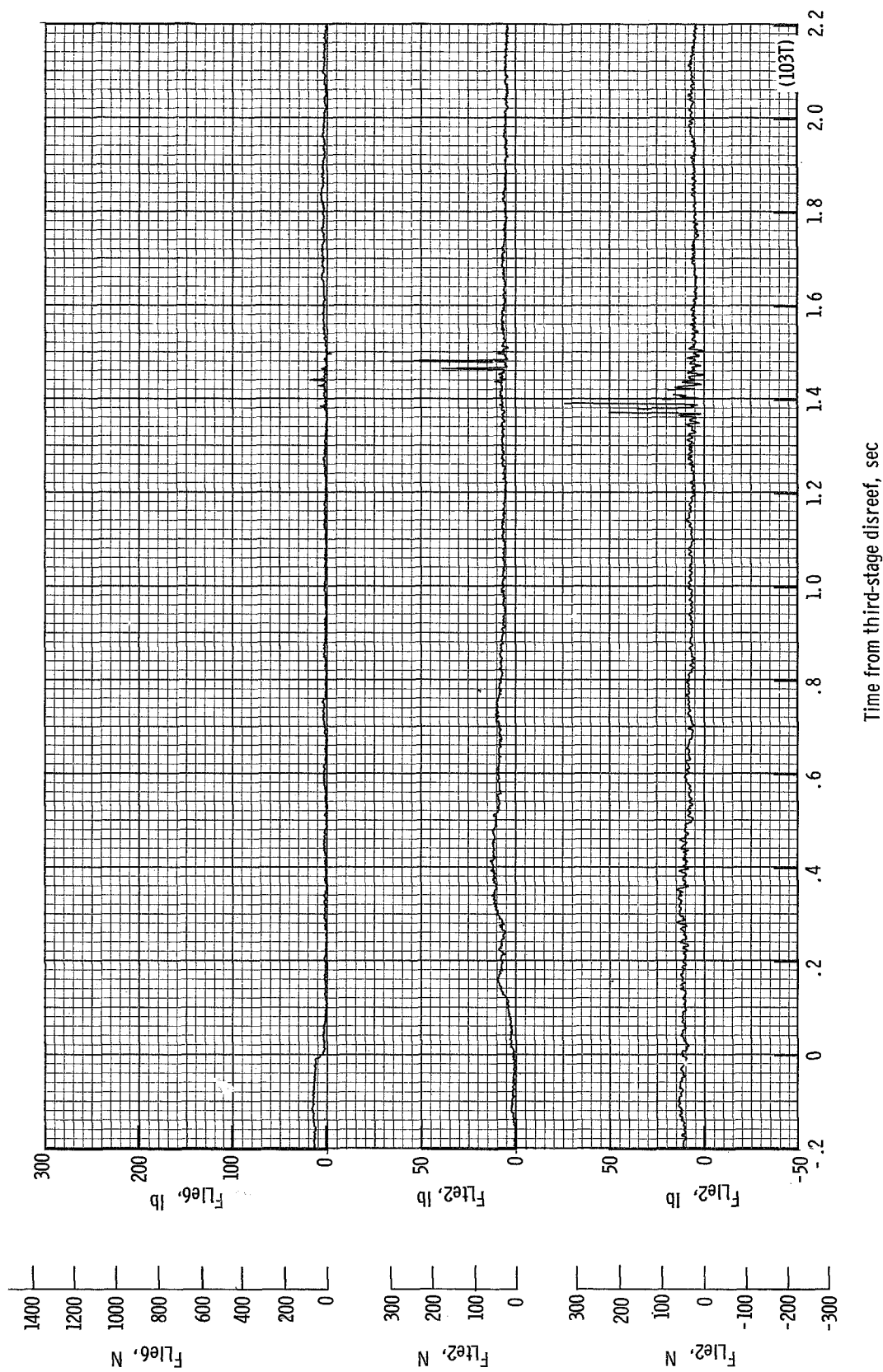
(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 30.51 seconds after launch.

Figure 25.- Continued.



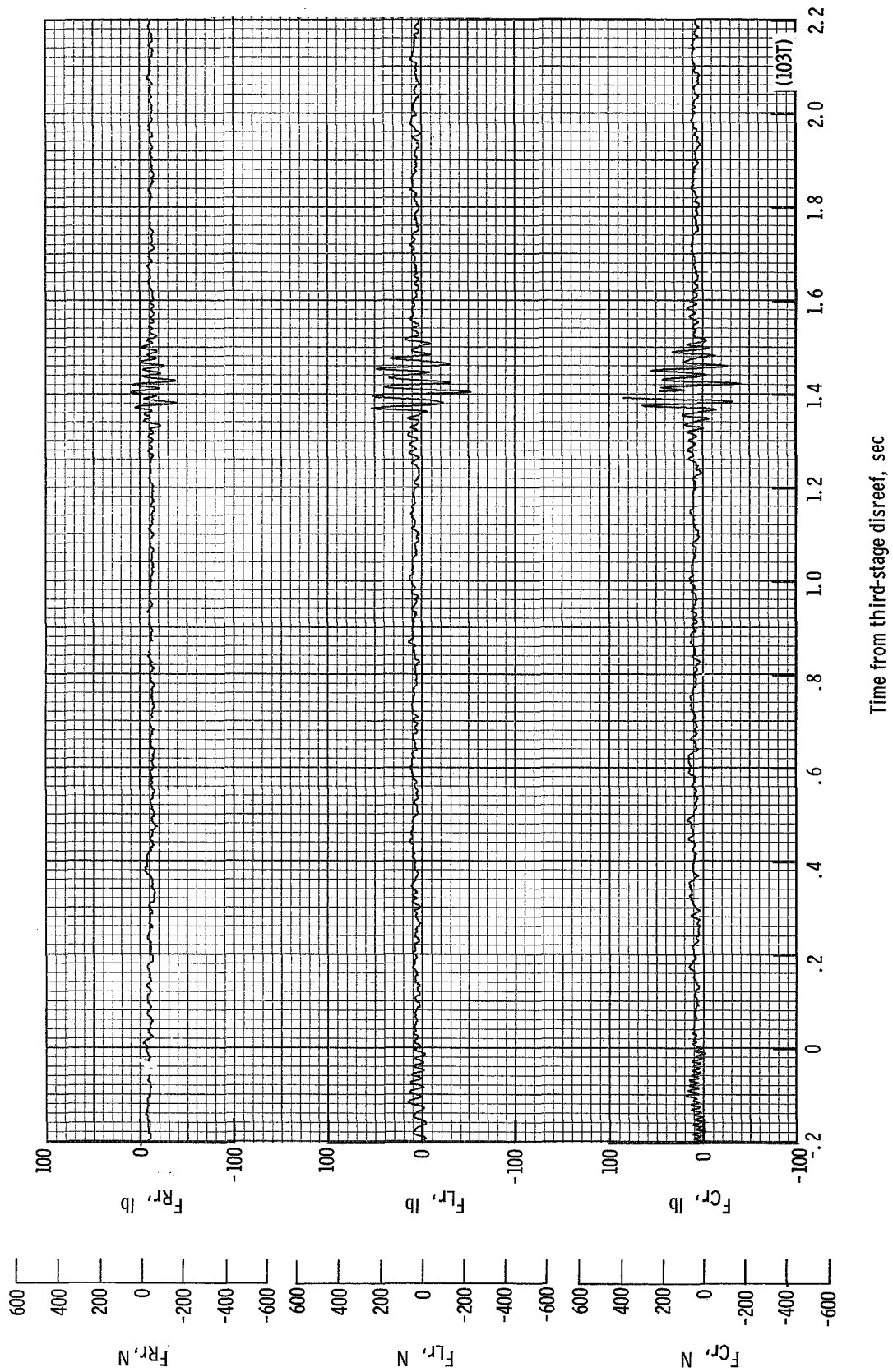
(p) Individual suspension-line loads $FLK3$, $FLK9$, $FLK6$, and $FLLe4$ plotted against time from third-stage disreef. Time = 0 second corresponds to 33.70 seconds after launch.

Figure 25.- Continued.



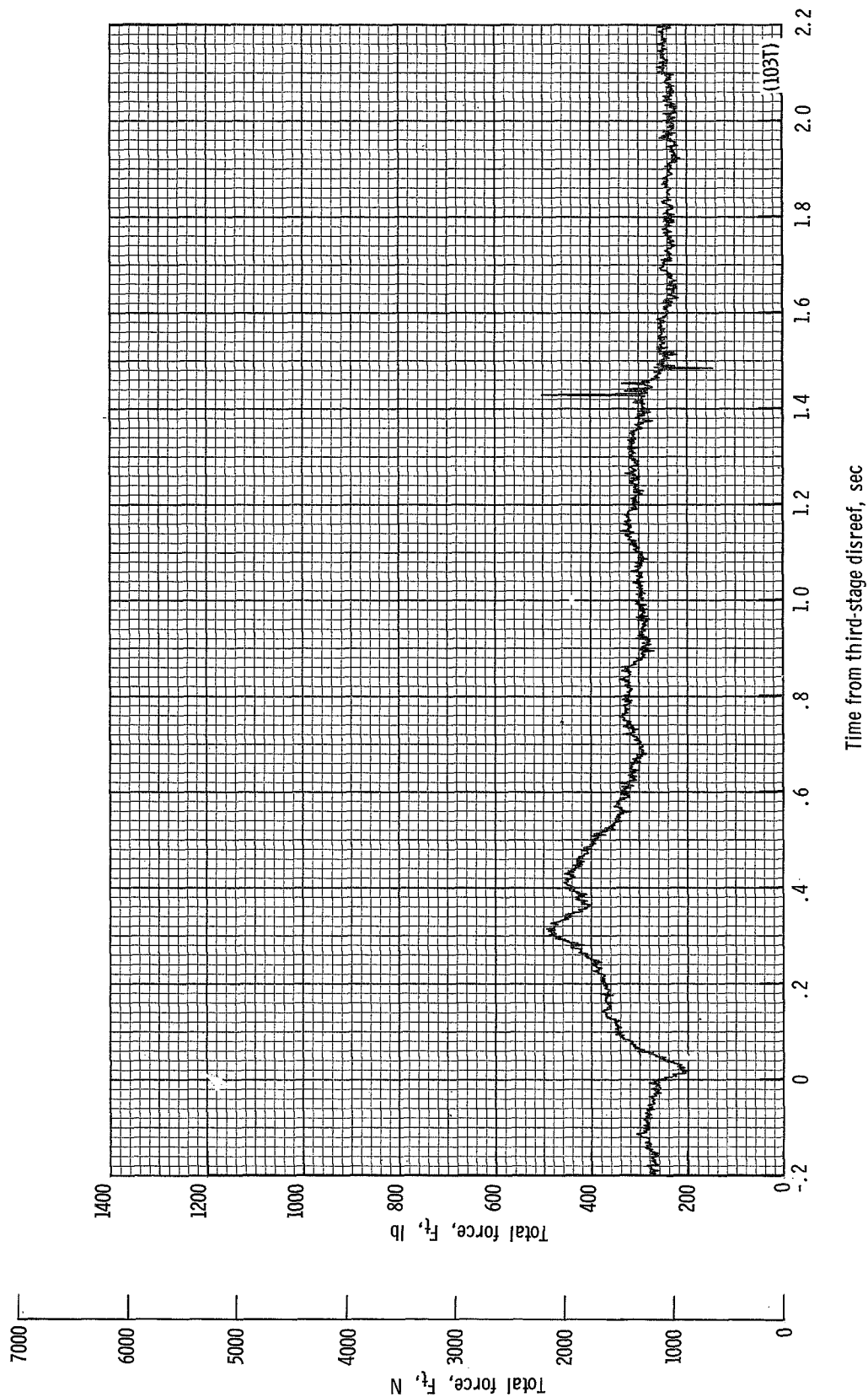
(q) Individual suspension-line loads F_{Lie2} , F_{Lte2} , and F_{Lie6} plotted against time from third-stage disreef. Time = 0 second corresponds to 33.70 seconds after launch.

Figure 25.- Continued.



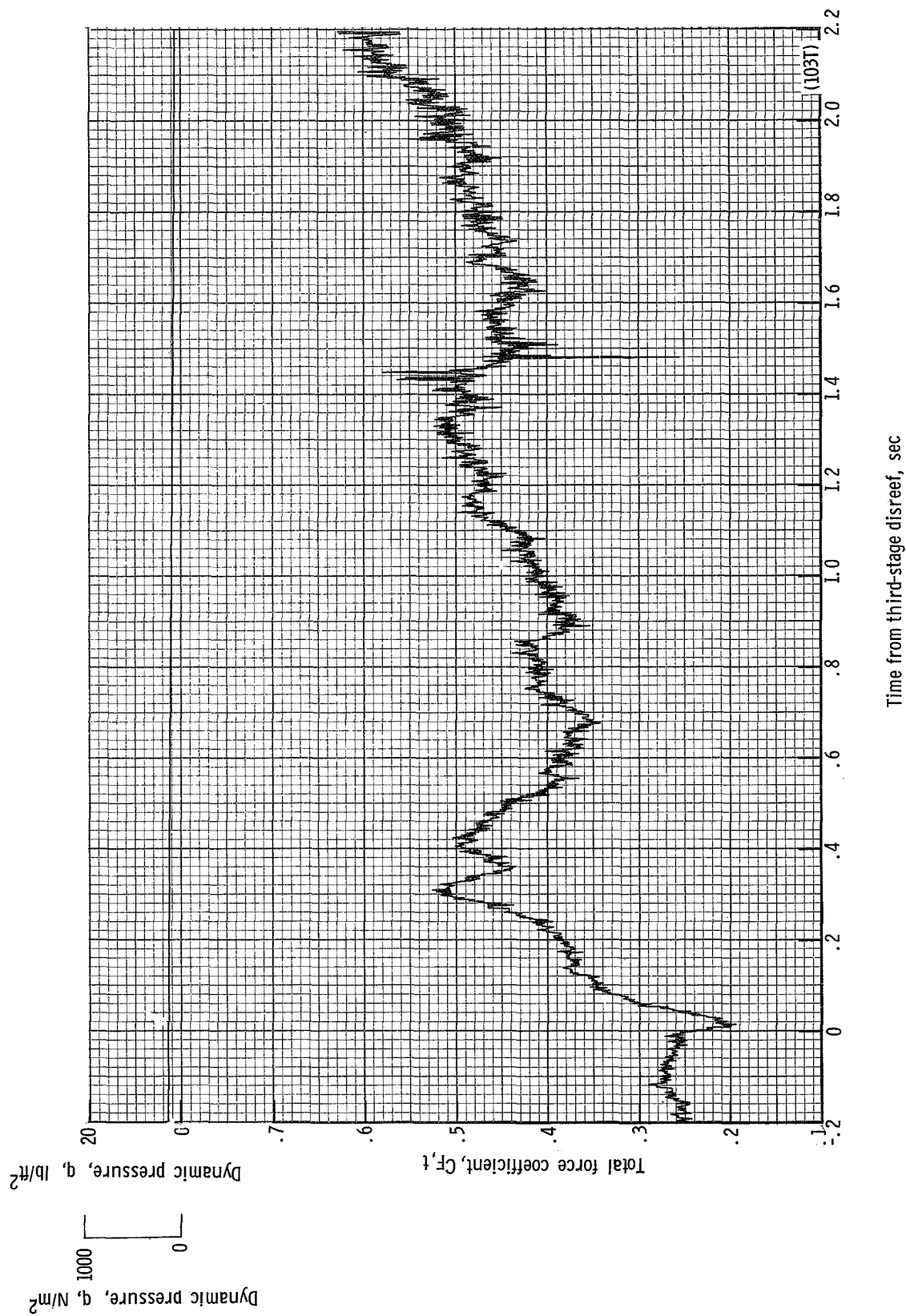
(r) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rr} plotted against time from third-stage disreef. Time = 0 second corresponds to 33.70 seconds after launch.

Figure 25.- Continued.



(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 33.70 seconds after launch.

Figure 25.- Continued.



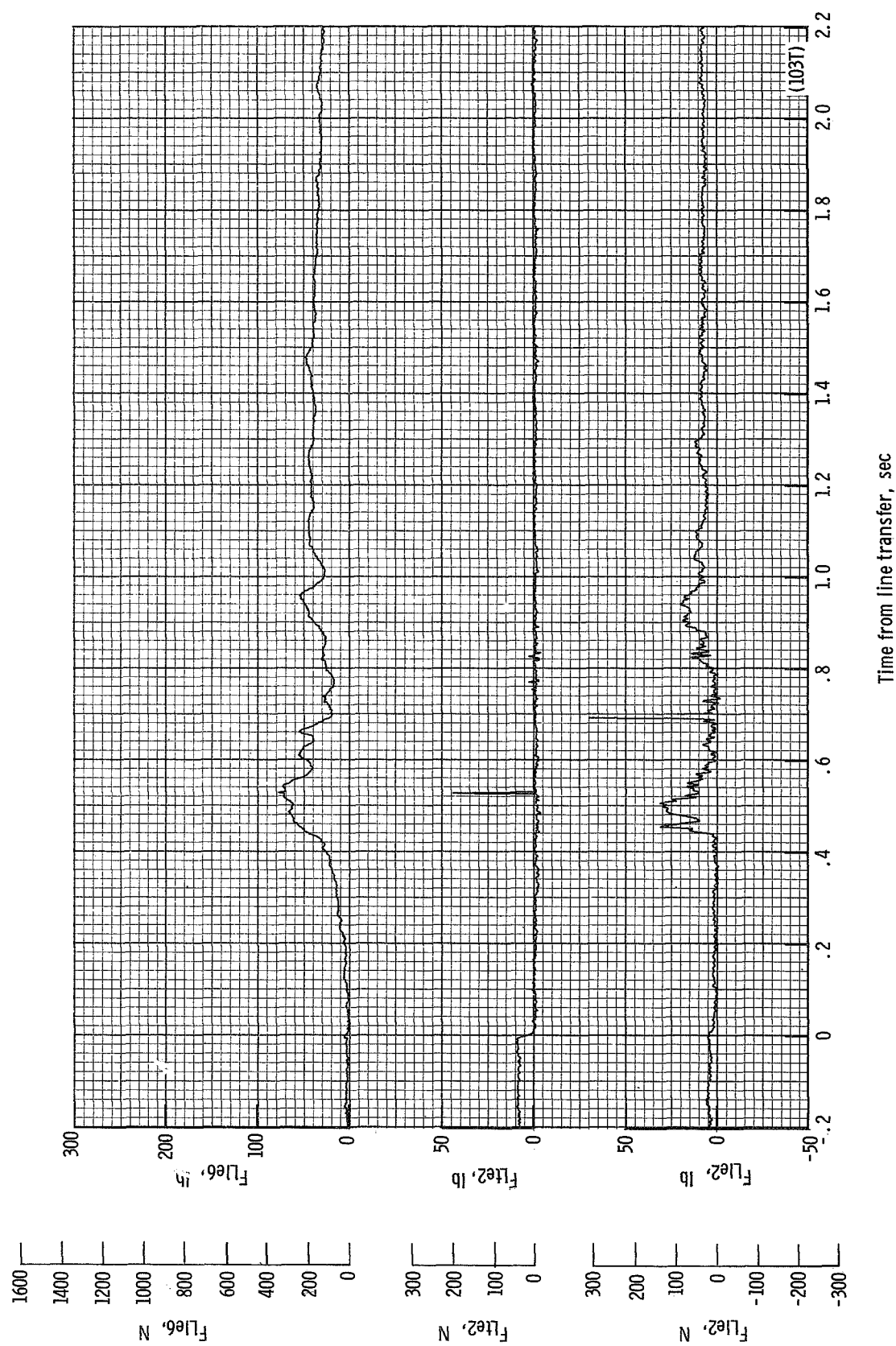
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 33.70 seconds after launch.

Figure 25.- Continued.



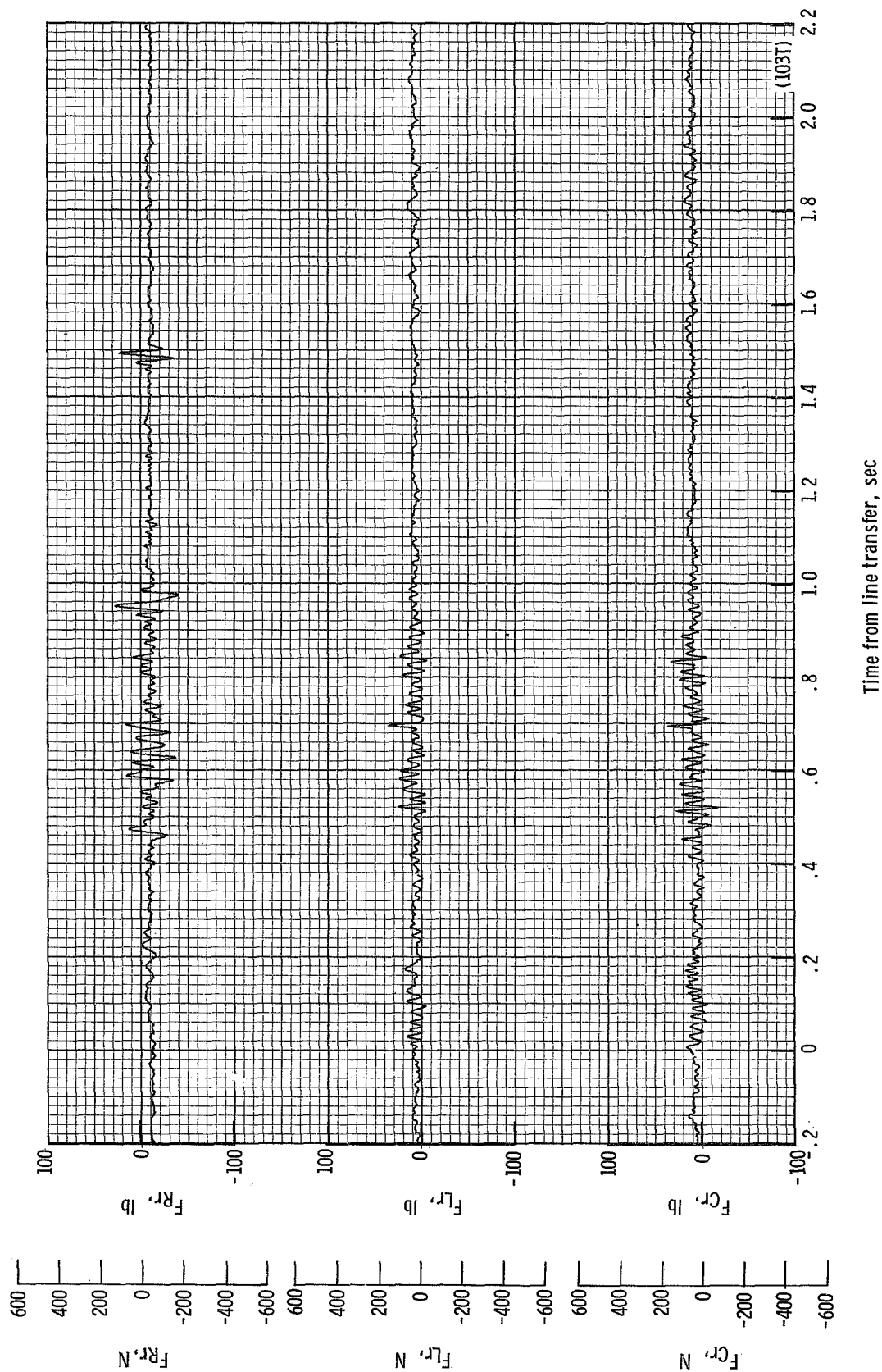
(u) Individual suspension-line loads F_{Lk3} , F_{Lk9} , F_{Lk6} and F_{Lk4} plotted against time from line transfer. Time = 0 second corresponds to 42.49 seconds after launch.

Figure 25.- Continued.



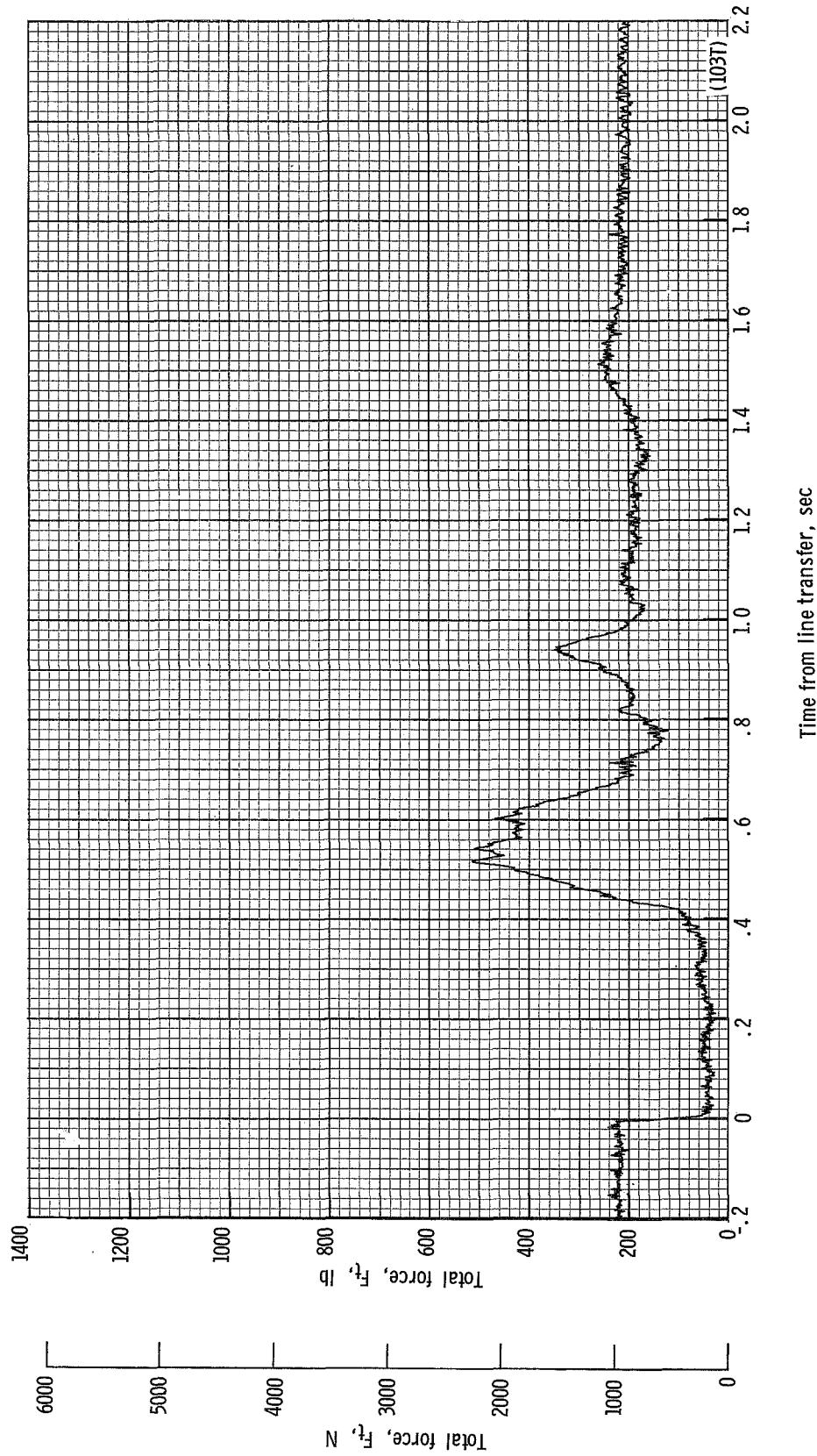
(v) Individual suspension-line loads F_{Lle2} , F_{Lle2} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 42.49 seconds after launch.

Figure 25.- Continued.



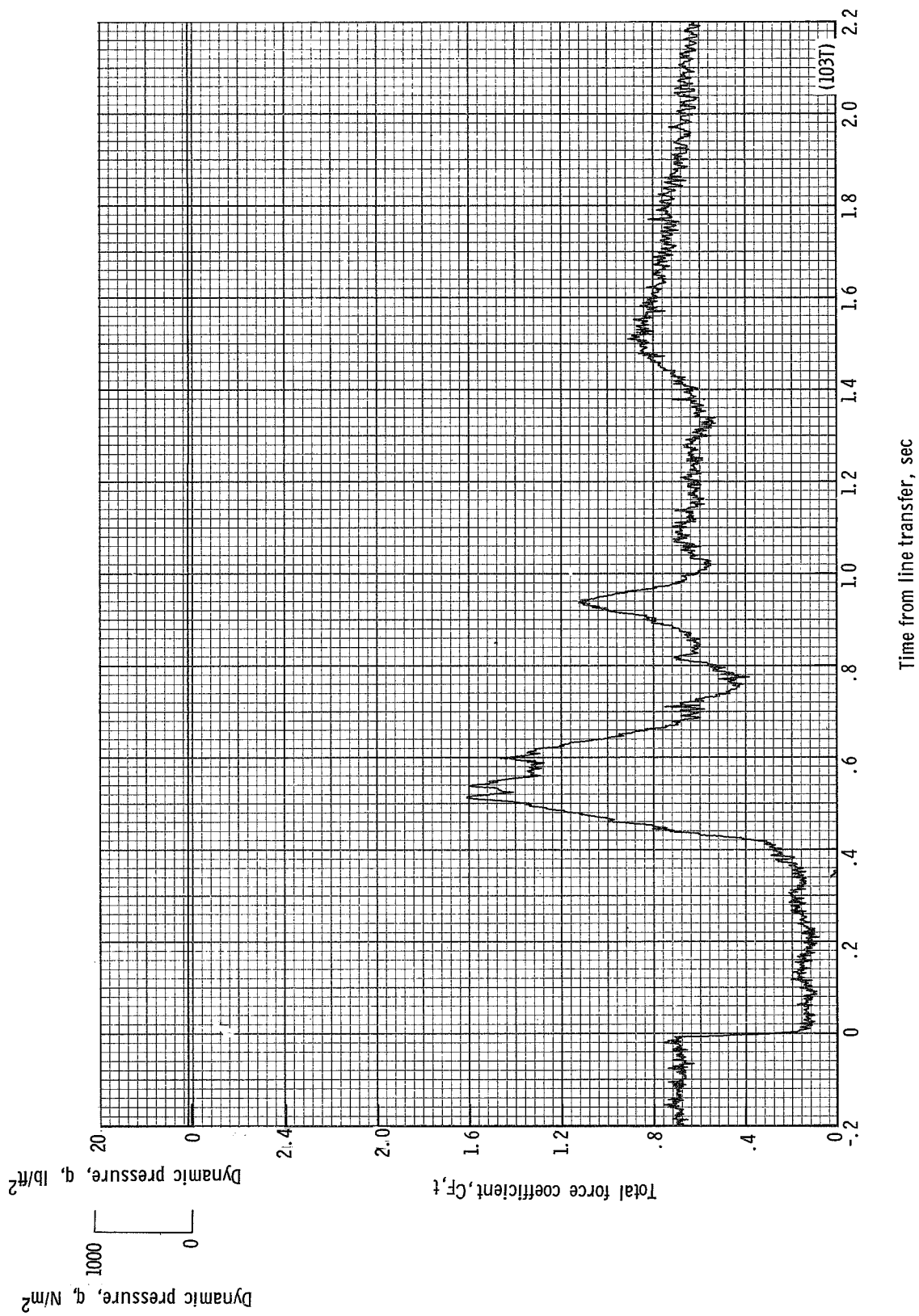
(w) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Rl} plotted against time from line transfer. Time = 0 second corresponds to 42.49 seconds after launch.

Figure 25.- Continued.



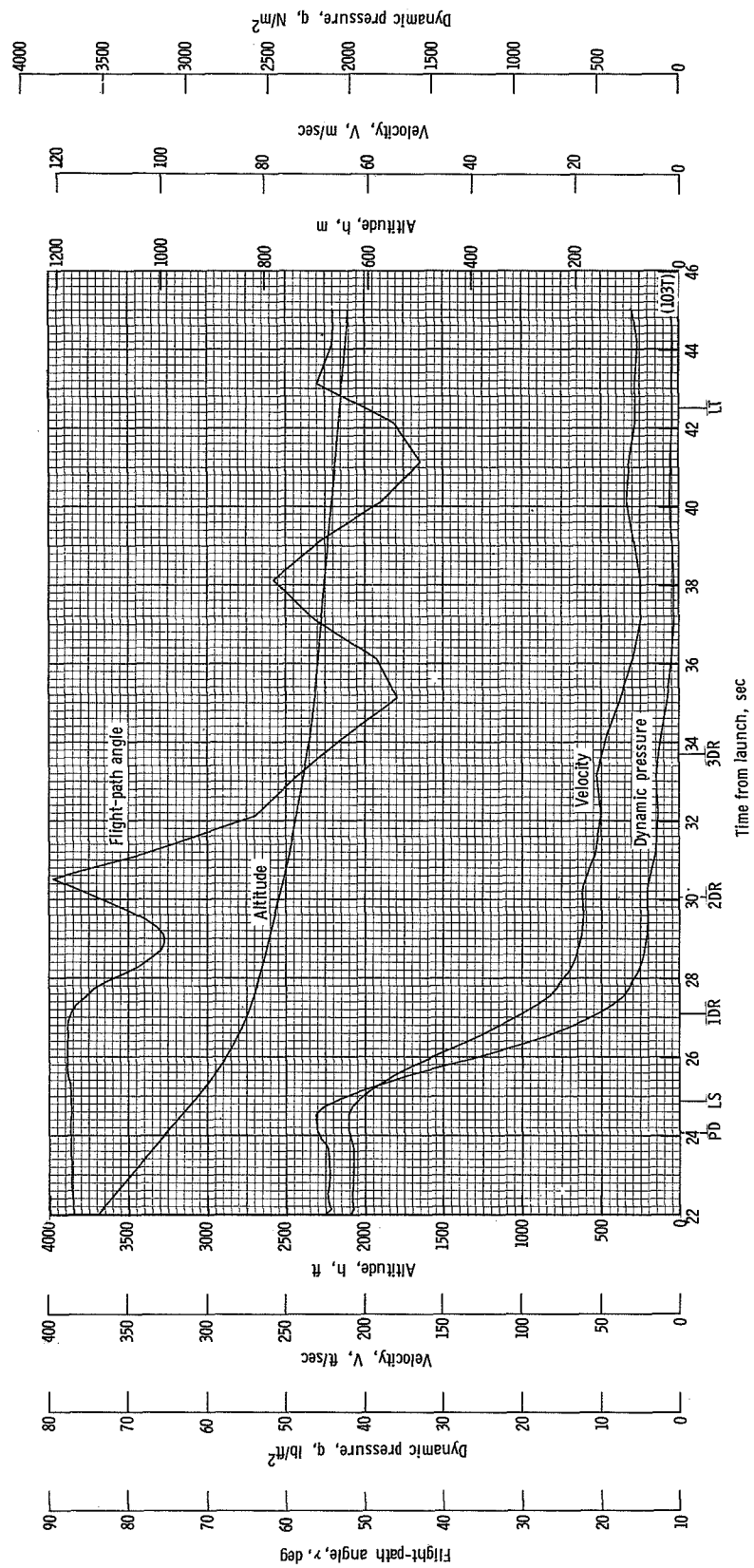
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 42.49 seconds after launch.

Figure 25.- Continued.



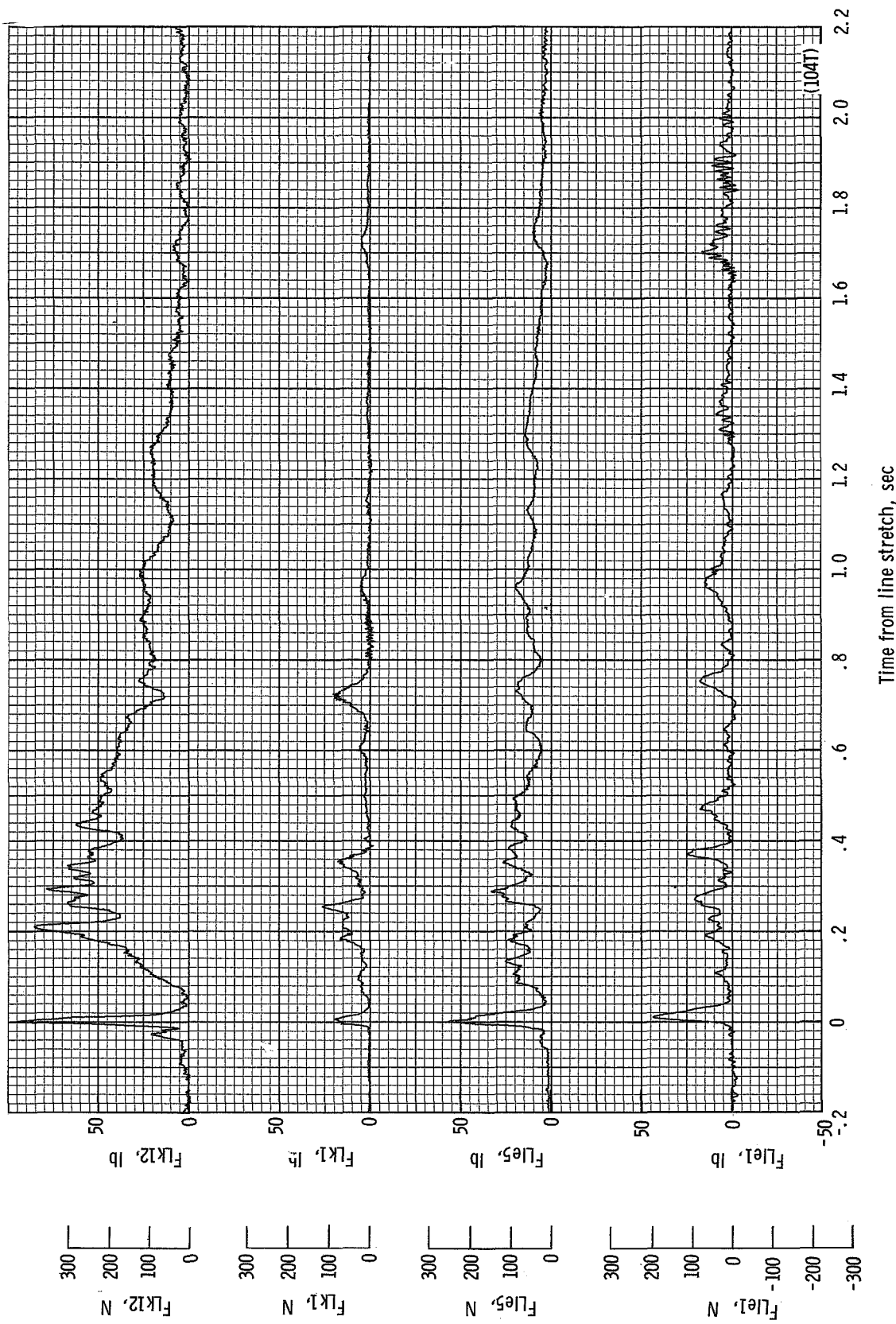
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 42.49 seconds after launch.

Figure 25.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

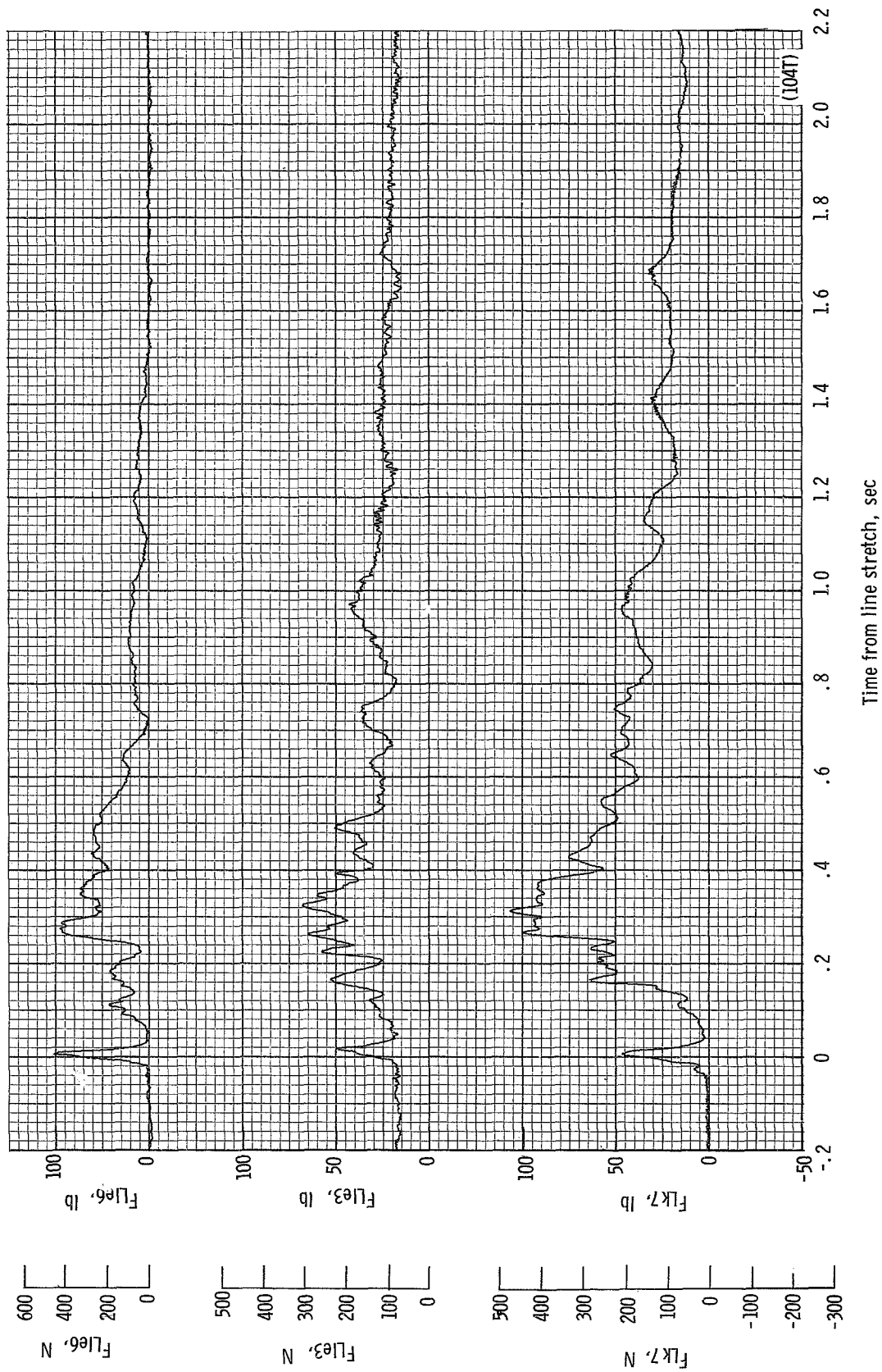
Figure 25.- Concluded.



(a) Individual suspension-line loads F_{LE1} , F_{LE5} , F_{LK1} , and F_{LK12} plotted against time from line stretch. Time = 0 second corresponds to 24.70 seconds after launch.

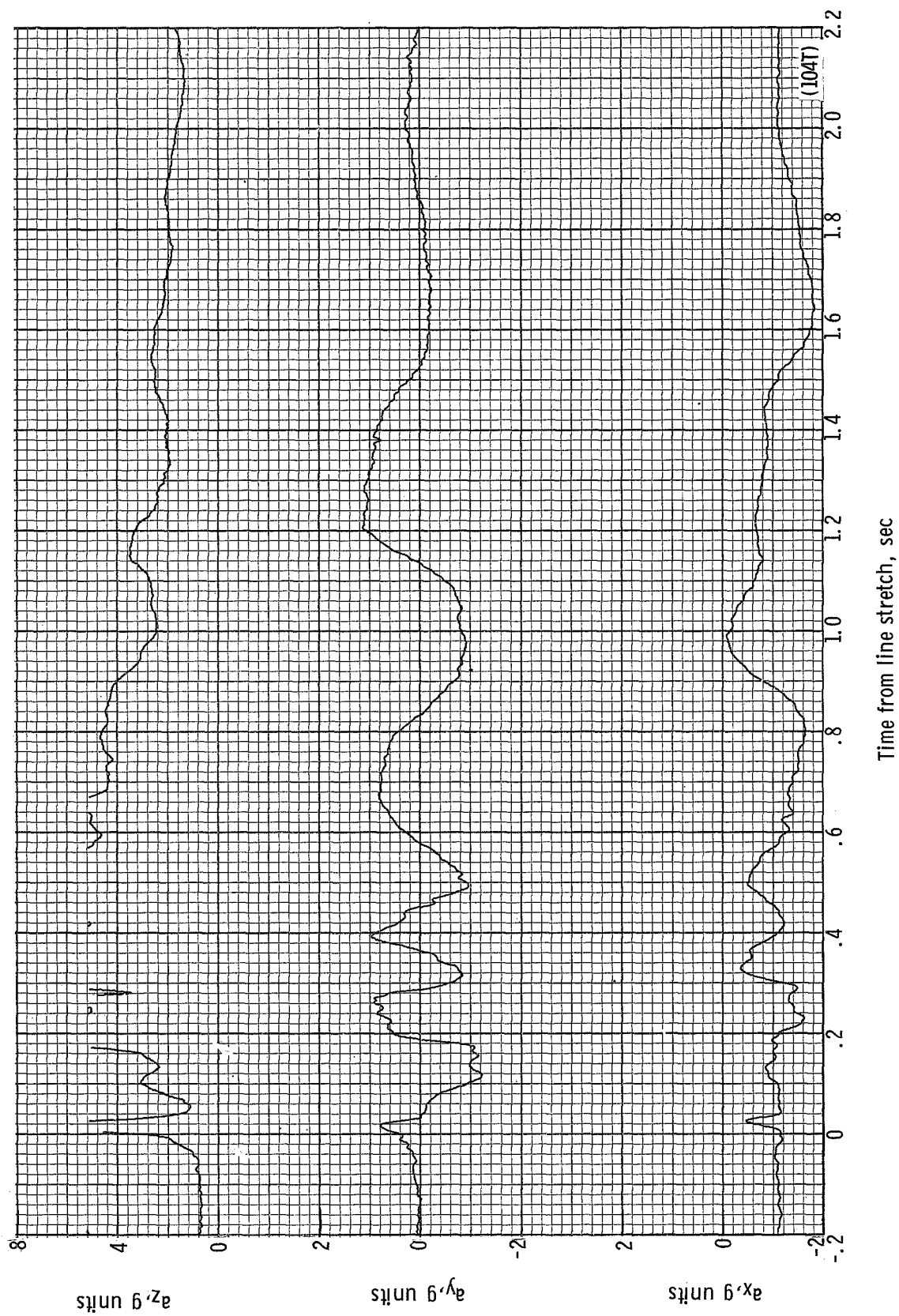
Figure 26.- Time history of twin-keel parawing deployment data for test 104T. $W_D = 1130.7 \text{ N}$ (254.2 lb); $W_P = 967.0 \text{ N}$ (217.4 lb); $q_{PD} = 2700.4 \text{ N/m}^2$ (56.4 lb/ft²);

$h_{PD} = 864 \text{ m}$ (2835 ft); $t_r/t_k = 0.219$; reefing version II.



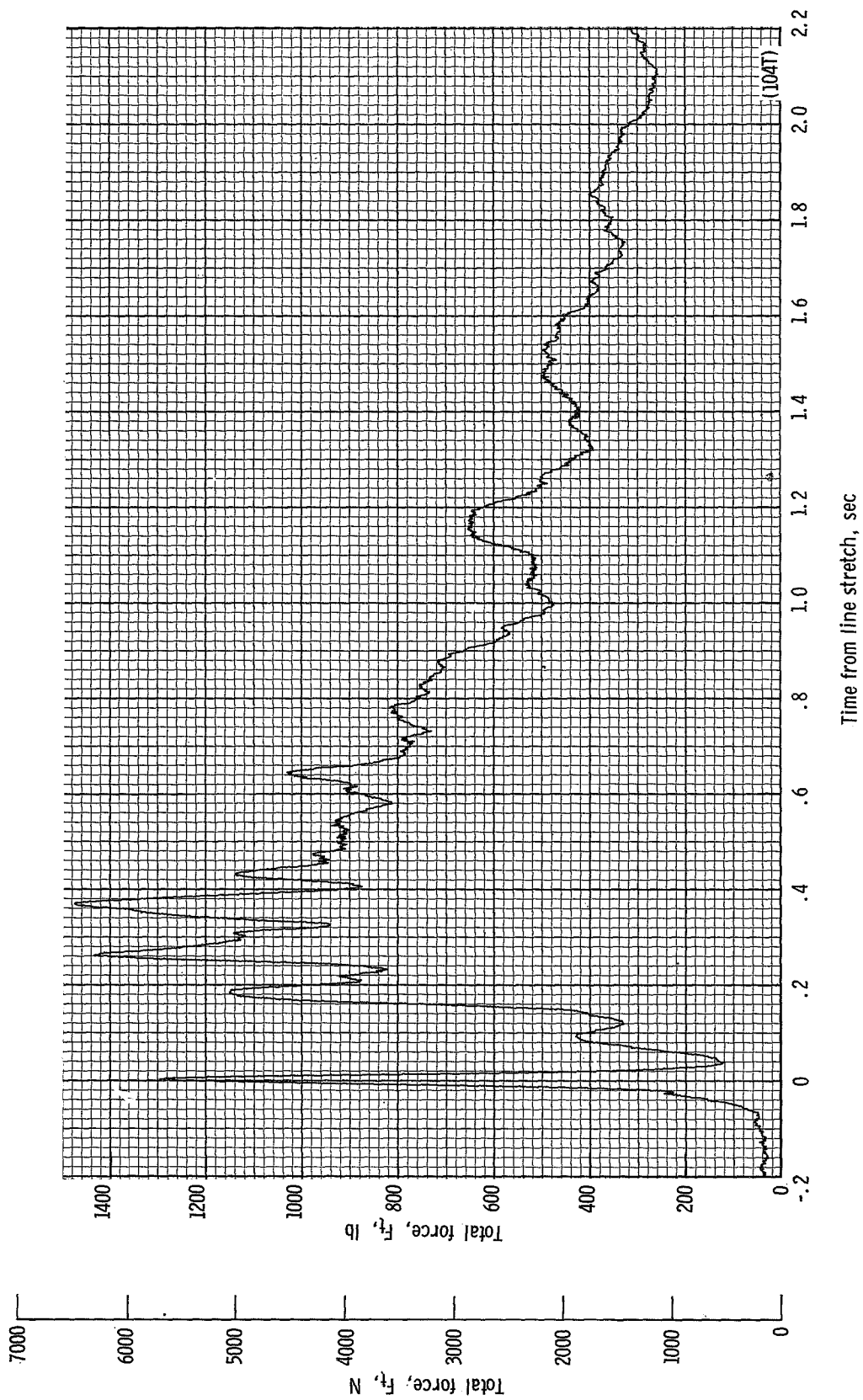
(b) Individual suspension-line loads F_{Lk7}, F_{Lle3}, and F_{Lle6} plotted against time from line stretch. Time = 0 second corresponds to 24.70 seconds after launch.

Figure 26.- Continued.



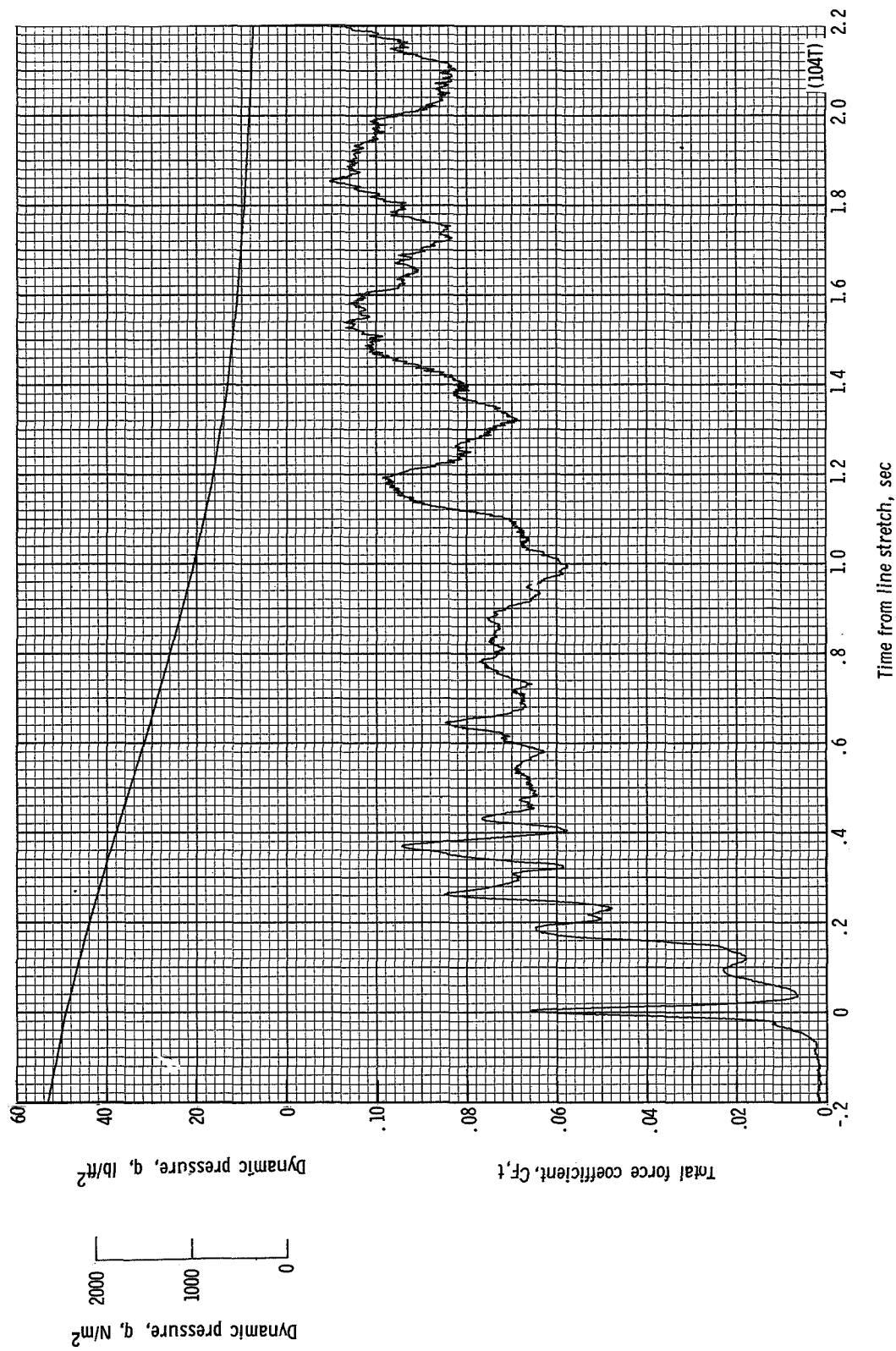
(c) Accelerations a_x , a_y , and a_z plotted against time from line stretch. Time = 0 second corresponds to 24.70 seconds after launch.

Figure 26.- Continued.



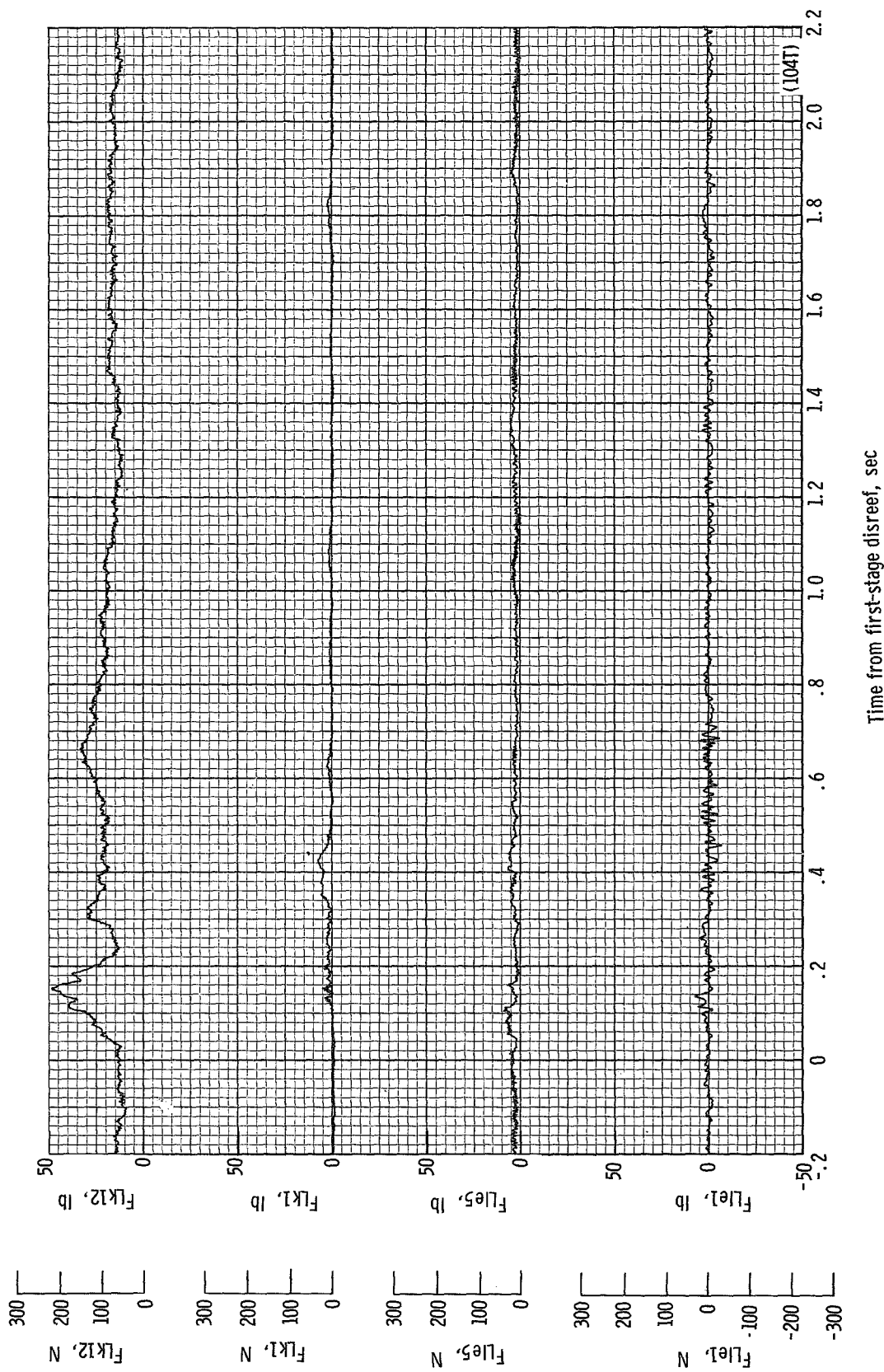
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 24.70 seconds after launch.

Figure 26.- Continued.



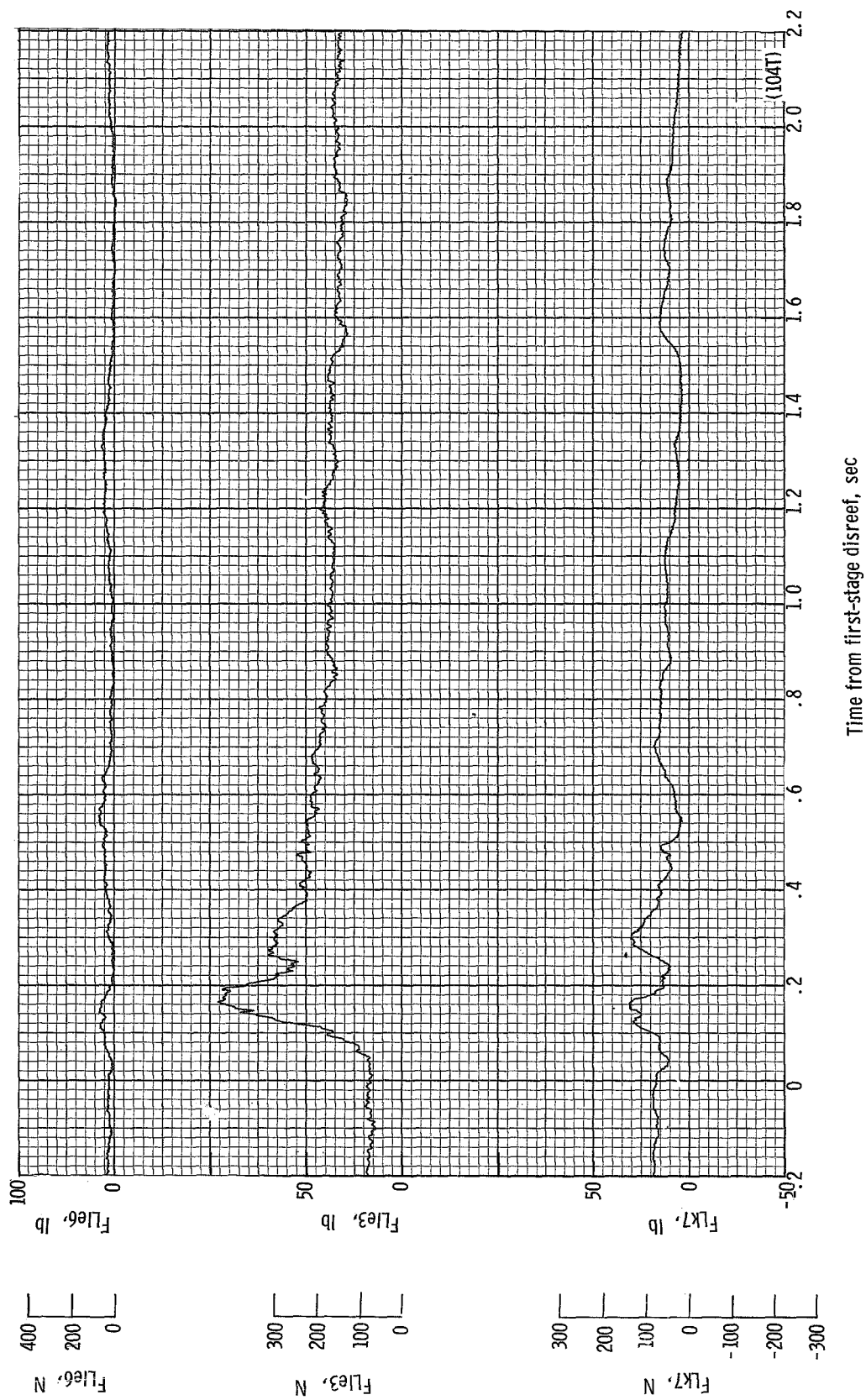
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 24.70 seconds after launch.

Figure 26.- Continued.



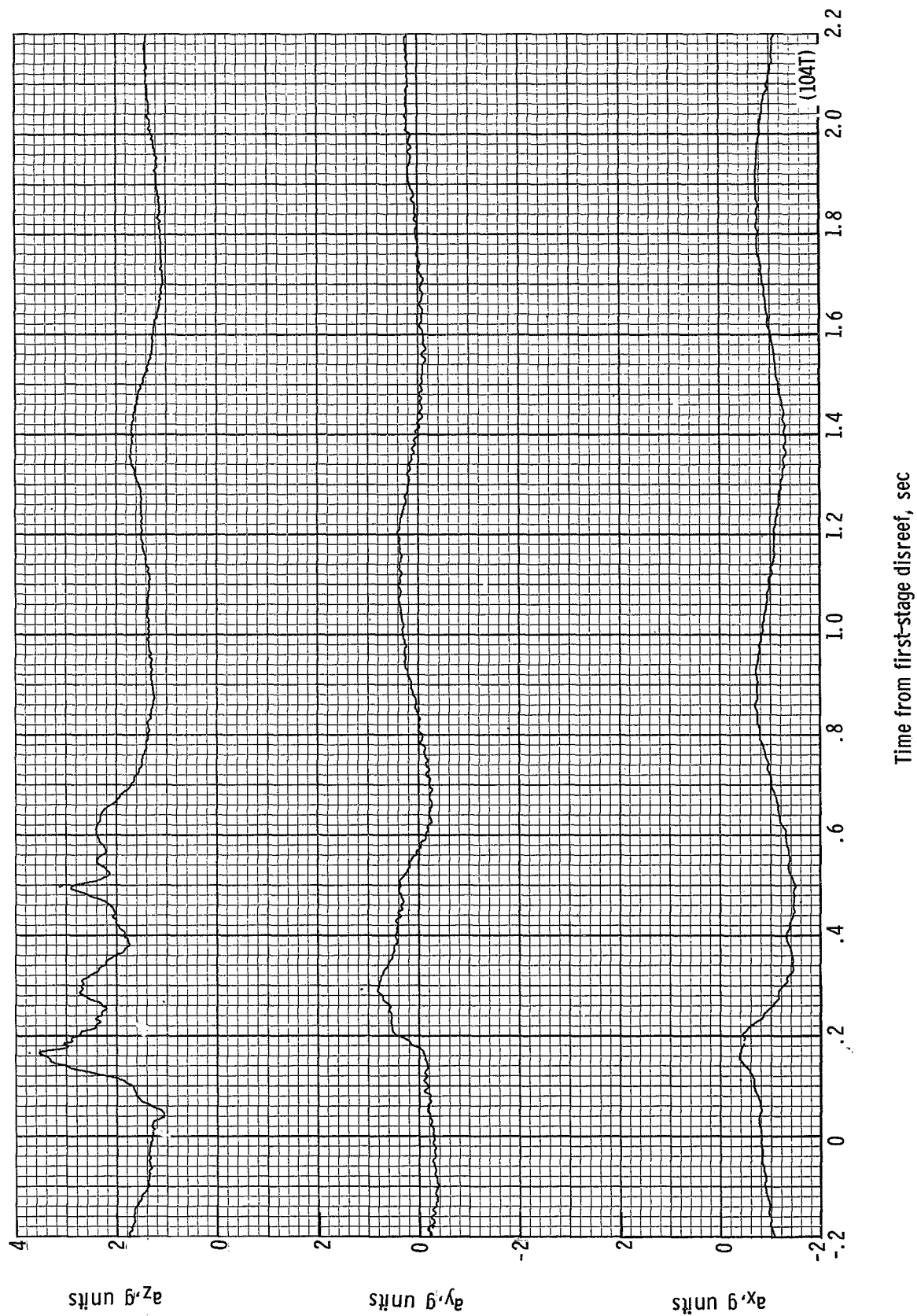
(f) Individual suspension-line loads F_{Lie1} , F_{Lie5} , F_{Lk1} , and F_{Lk12} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.17 seconds after launch.

Figure 26.- Continued.



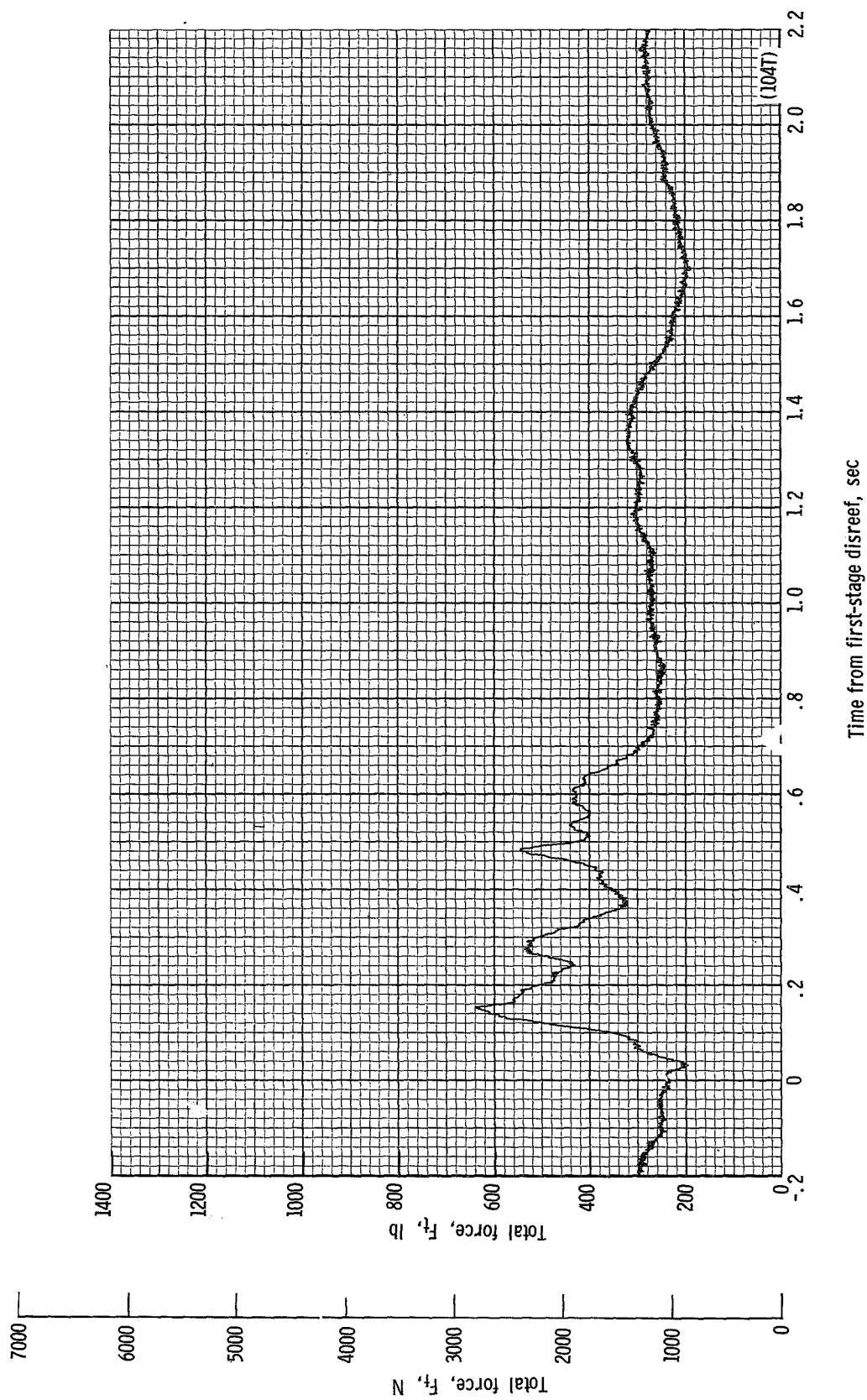
(g) Individual suspension-line loads F_{LK7} , F_{LIe3} , and F_{LIe6} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.17 seconds after launch.

Figure 26.- Continued.



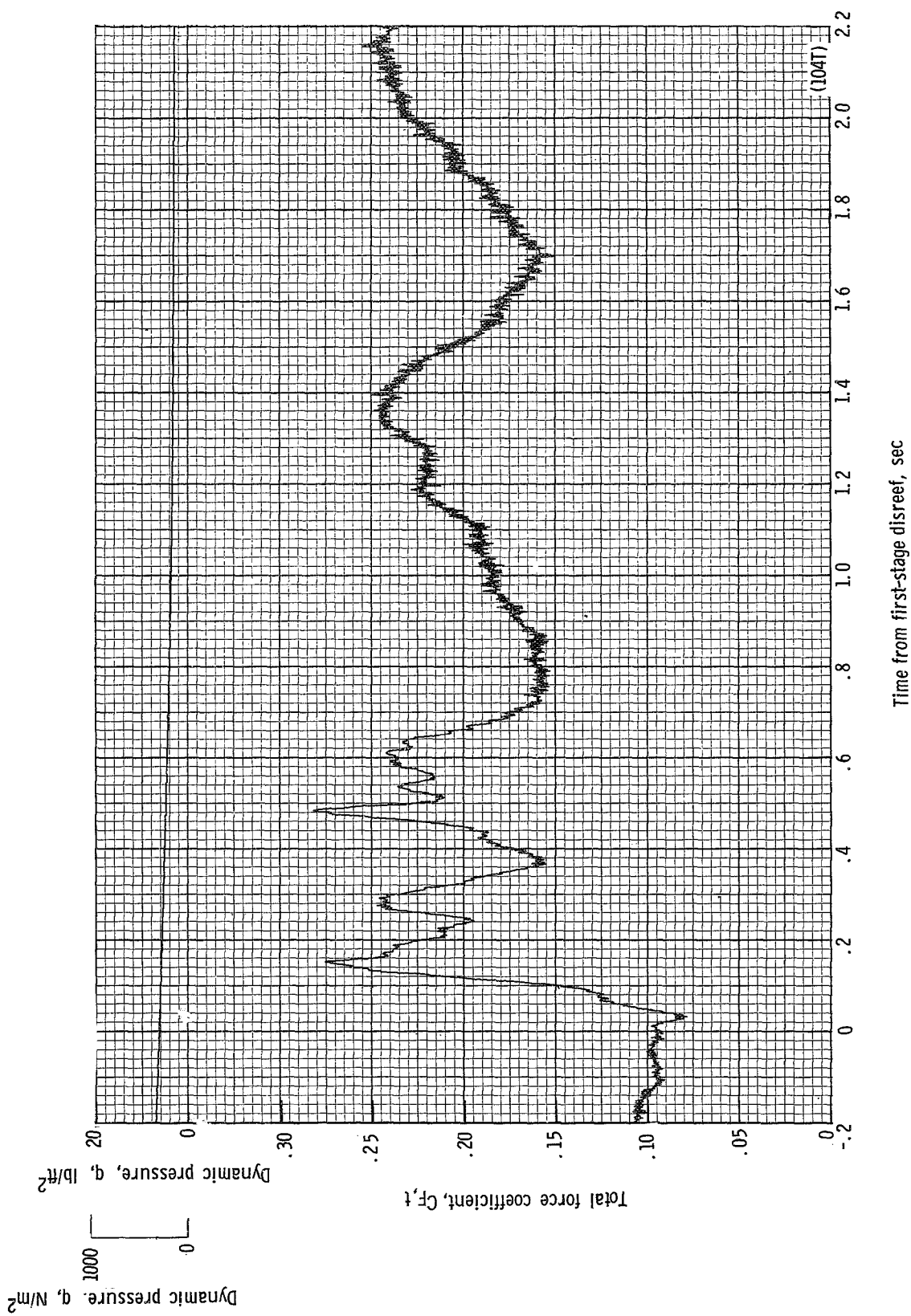
(h) Accelerations a_x , a_y , and a_z plotted against time from first-stage disreef. Time = 0 second corresponds to 26.17 seconds after launch.

Figure 26.- Continued.



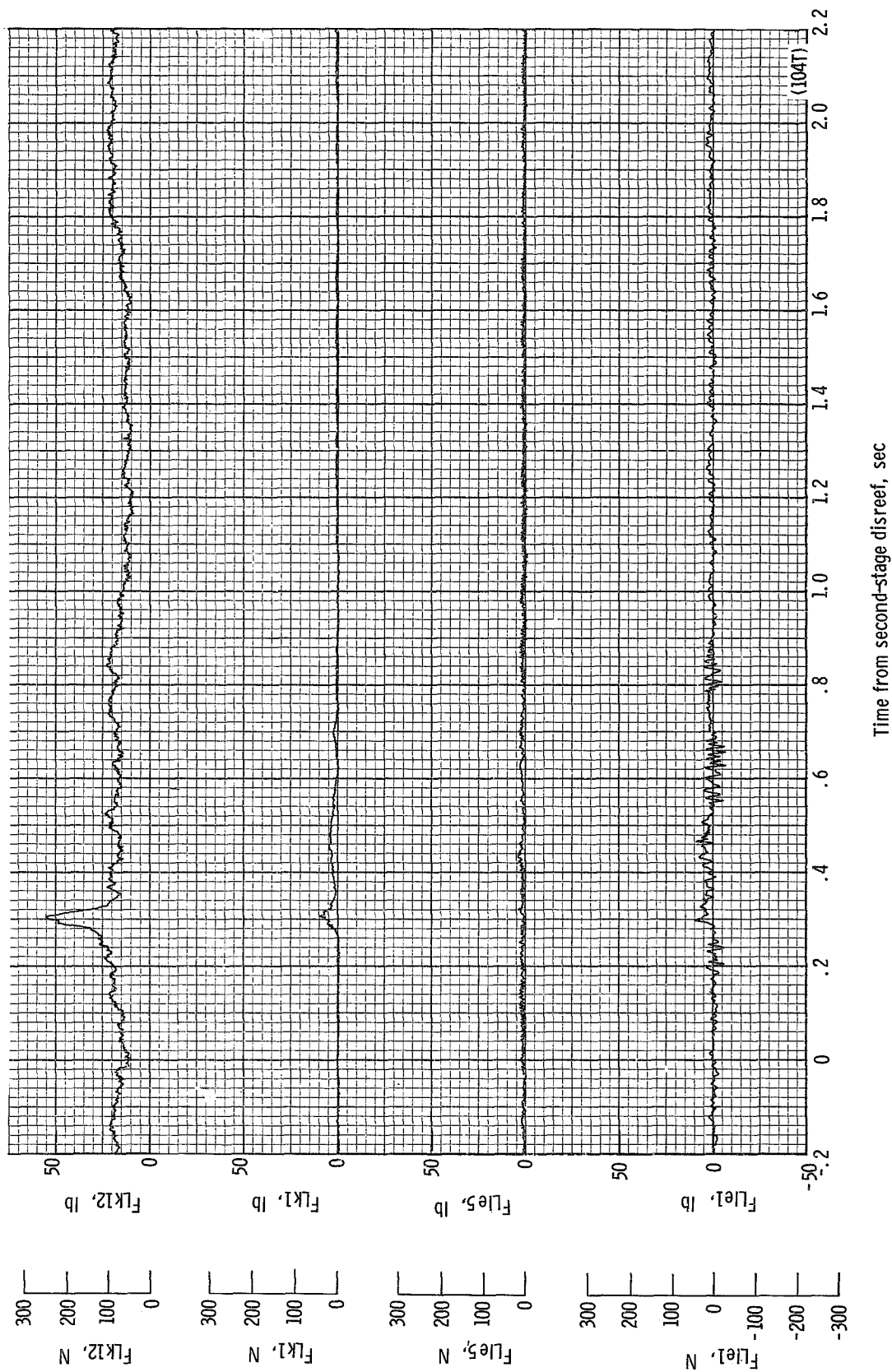
(1) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 26.17 seconds after launch.

Figure 26.- Continued.



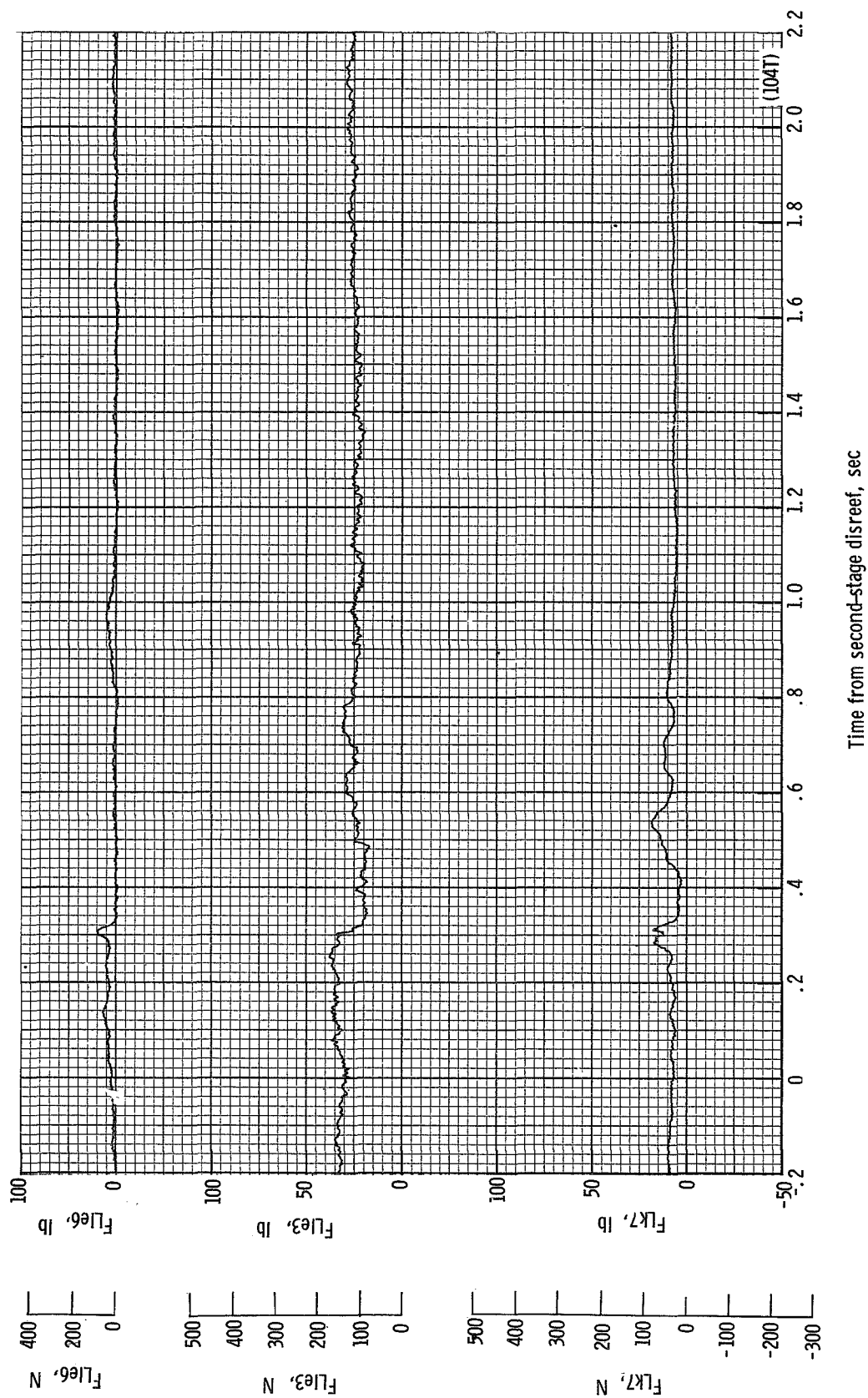
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 26.17 seconds after launch.

Figure 26.- Continued.



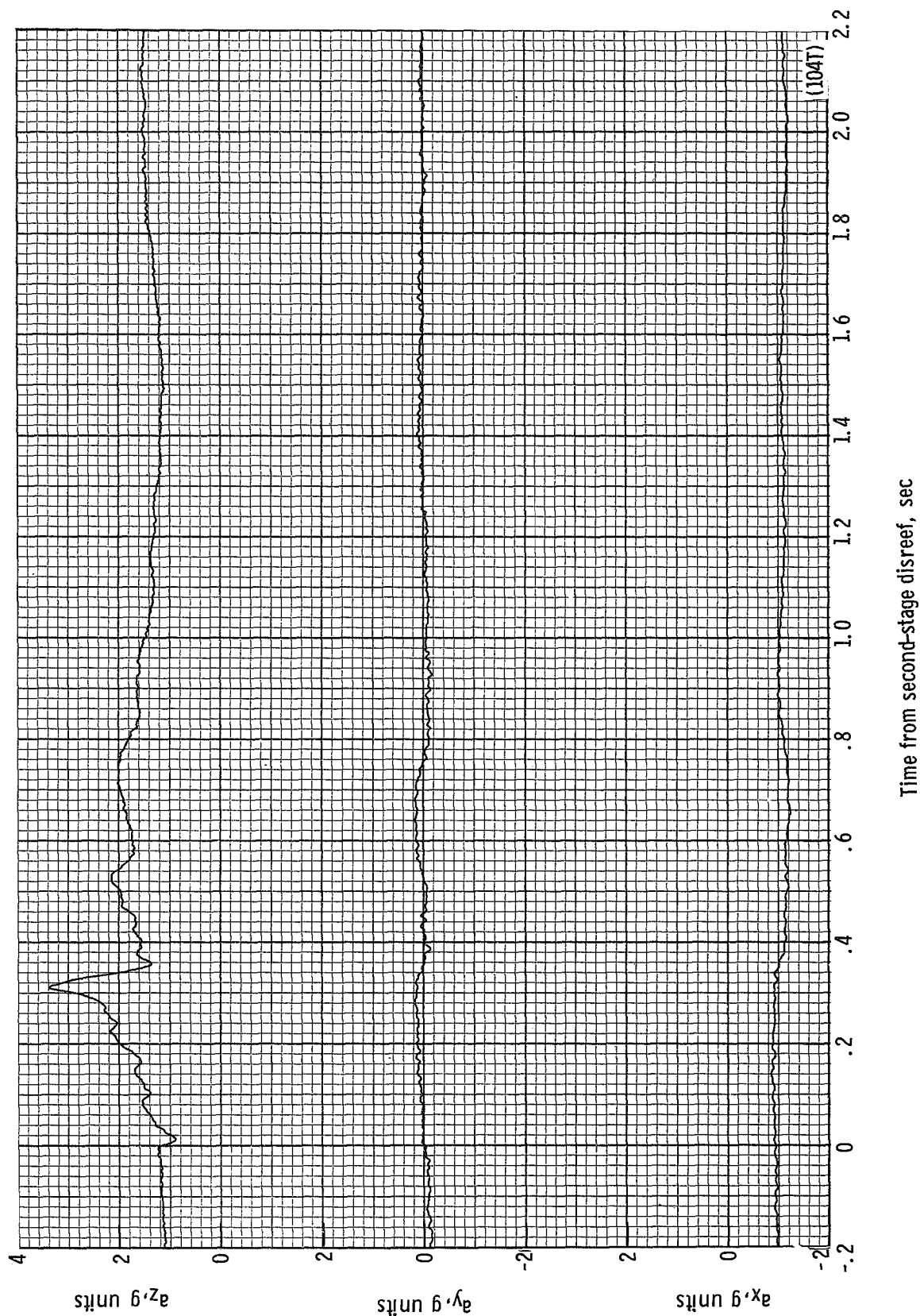
(k) Individual suspension-line loads FL_{1e1} , FL_{5e5} , FL_{K1} , and FL_{K12} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.17 seconds after launch.

Figure 26.- Continued.

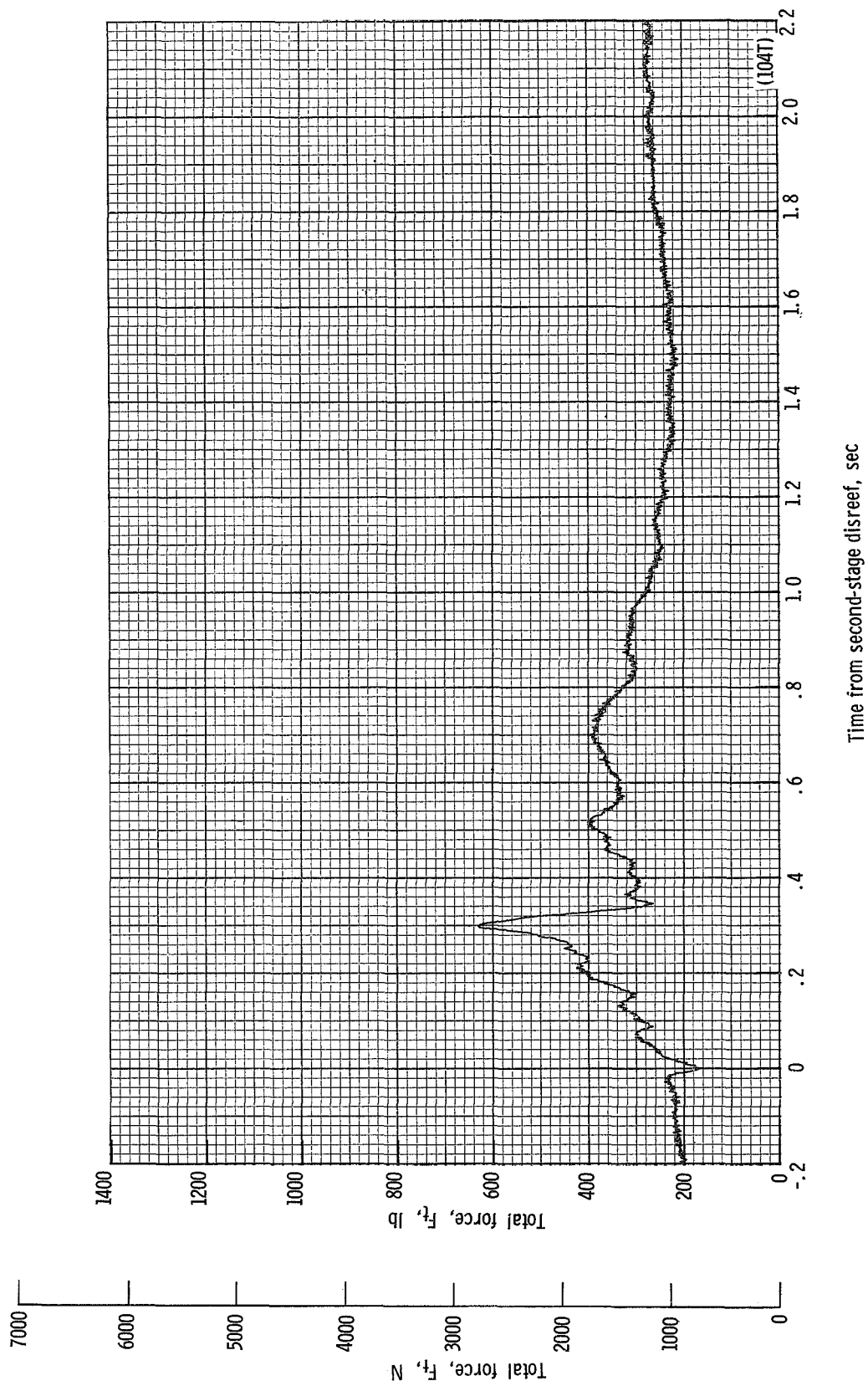


(1) Individual suspension-line loads $FLK7$, $FLie3$, and $FLie6$ plotted against time from second-stage disreef. Time = 0 second corresponds to 30.17 seconds after launch.

Figure 26.- Continued.

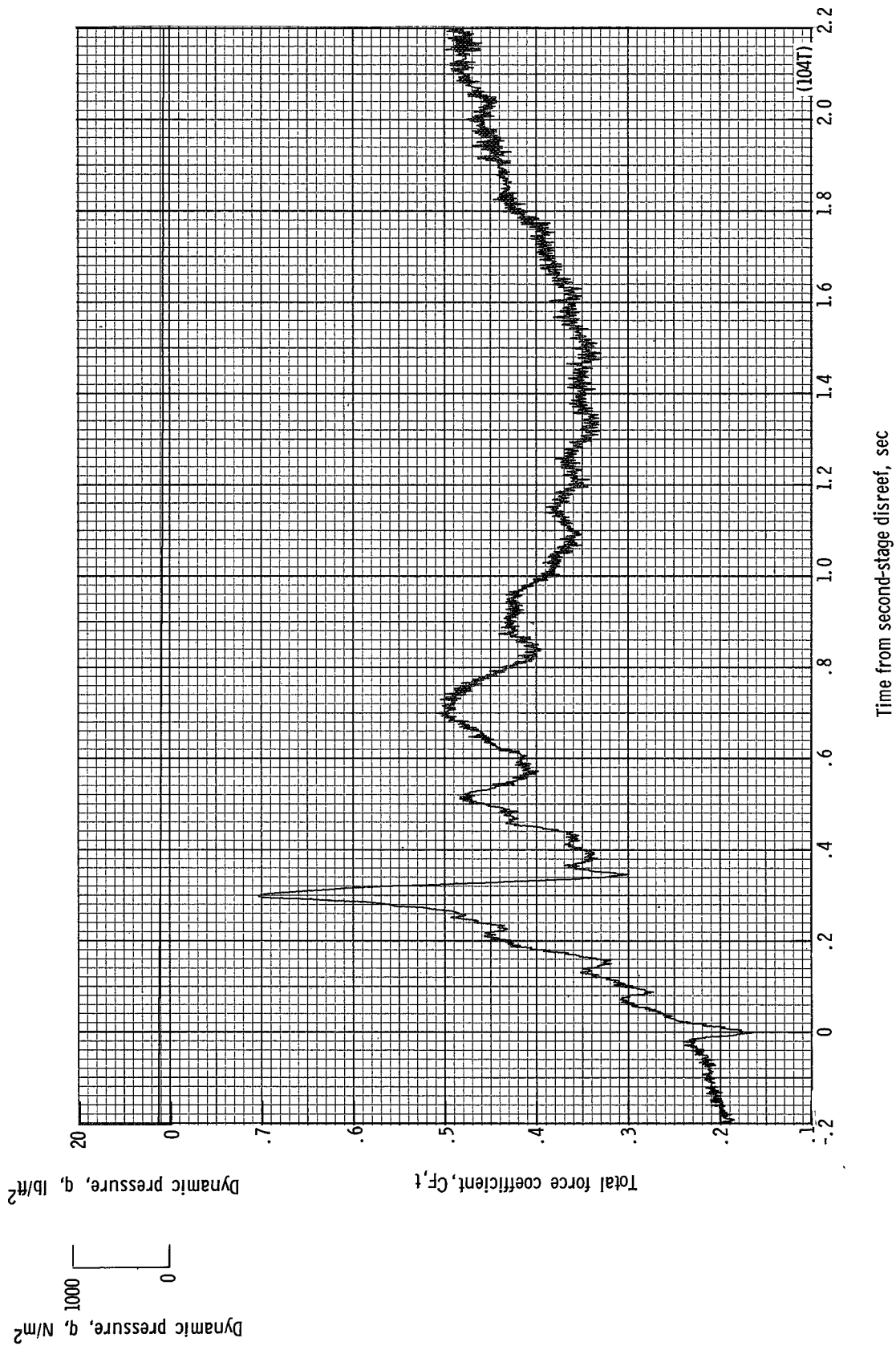


(m) Accelerations a_x , a_y , and a_z plotted against time from second-stage disreef. Time = 0 second corresponds to 30.17 seconds after launch.
Figure 26.- Continued.



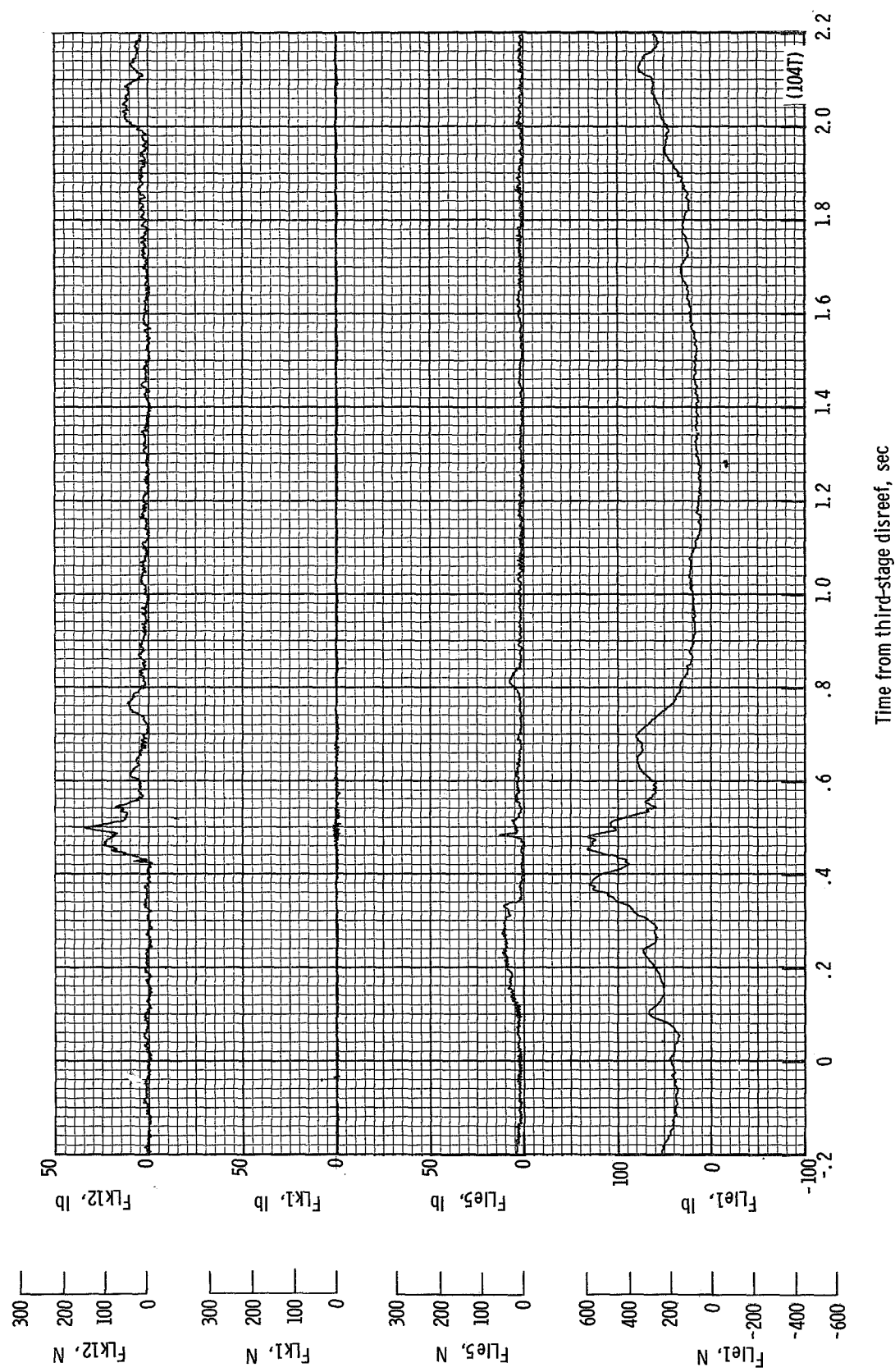
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 30.17 seconds after launch.

Figure 26.- Continued.



(o) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 30.17 seconds after launch.

Figure 26.- Continued.



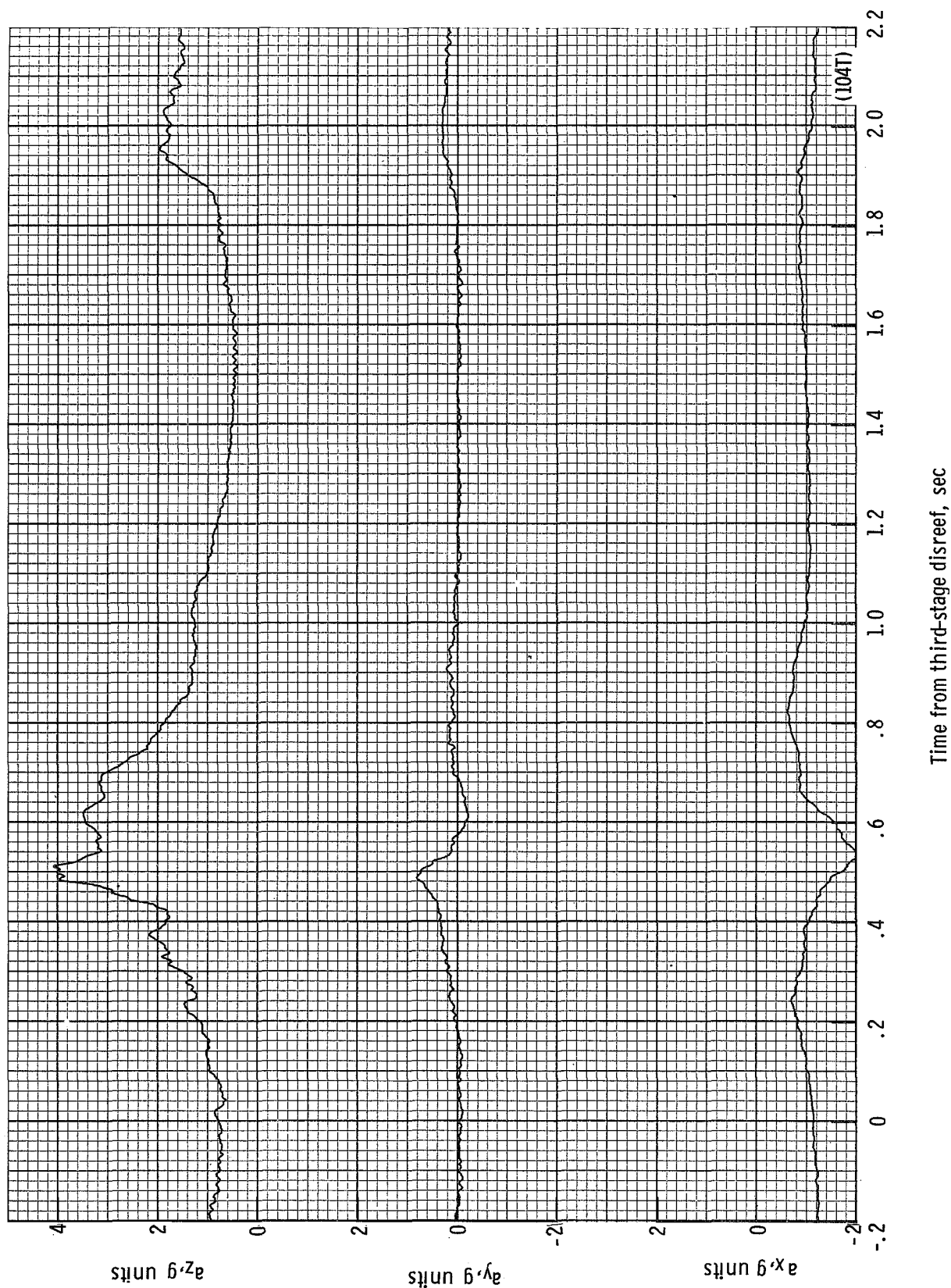
(p) Individual suspension-line loads F_{Le1} , F_{Le5} , F_{LK1} , and F_{LK12} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.65 seconds after launch.

Figure 26.- Continued.



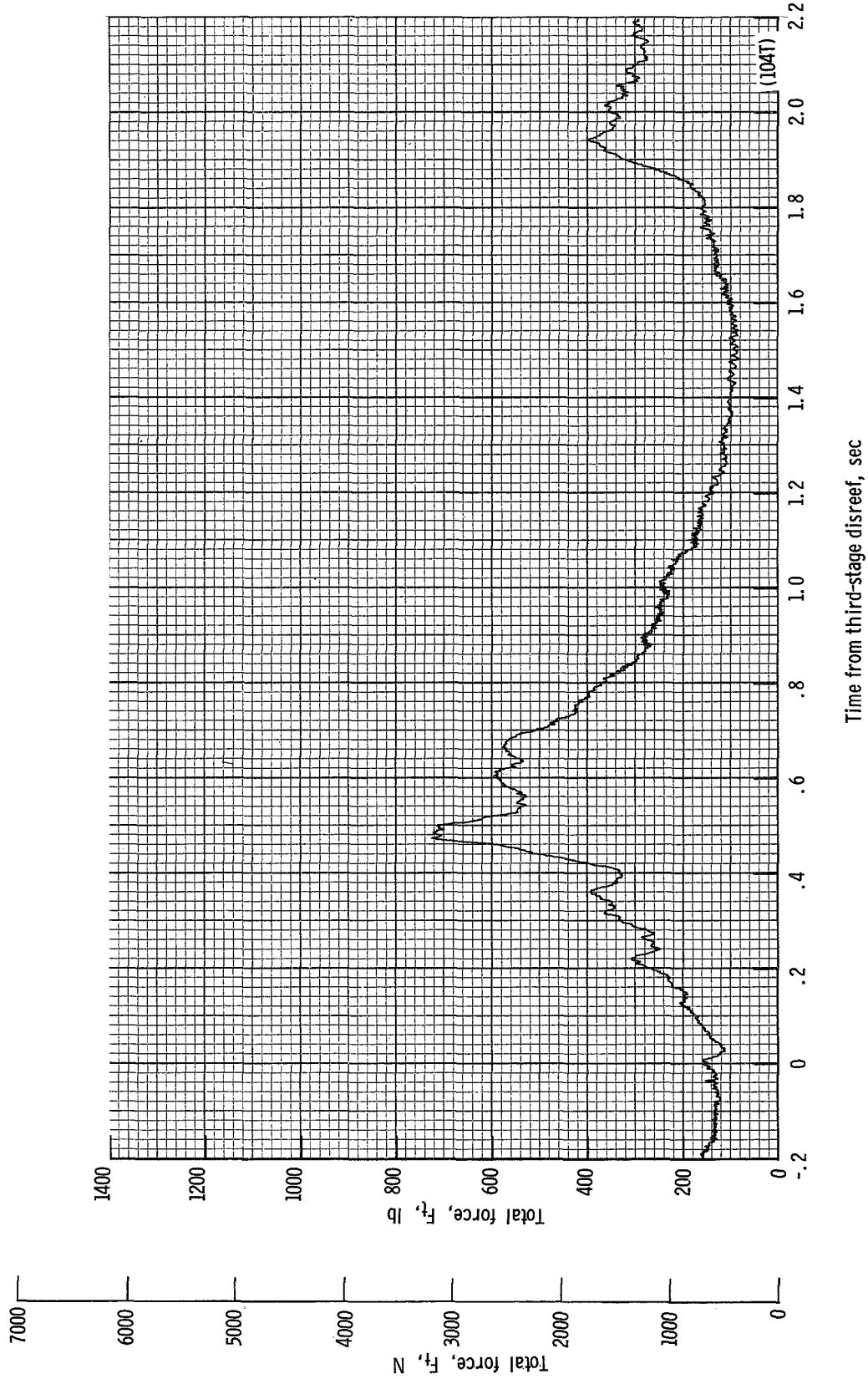
(q) Individual suspension-line loads F_{Lk7} , F_{Lle3} , and F_{Lle6} plotted against time from third-stage disreef. Time = 0 second corresponds to 36.65 seconds after launch.

Figure 26.- Continued.



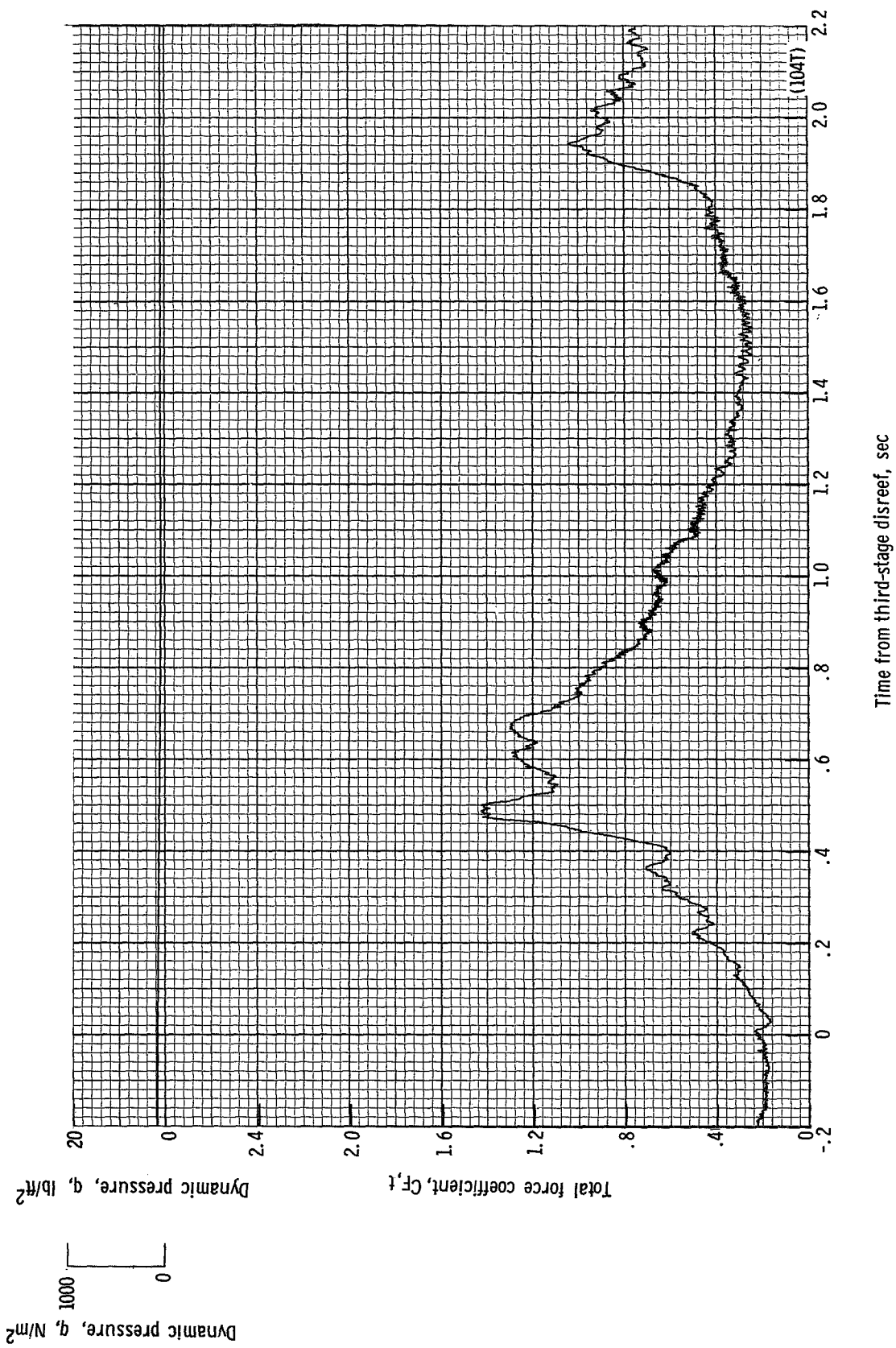
(r) Accelerations a_x , a_y , and a_z plotted against time from third-stage disreef. Time = 0 second corresponds to 36.65 seconds after launch.

Figure 26.- Continued.



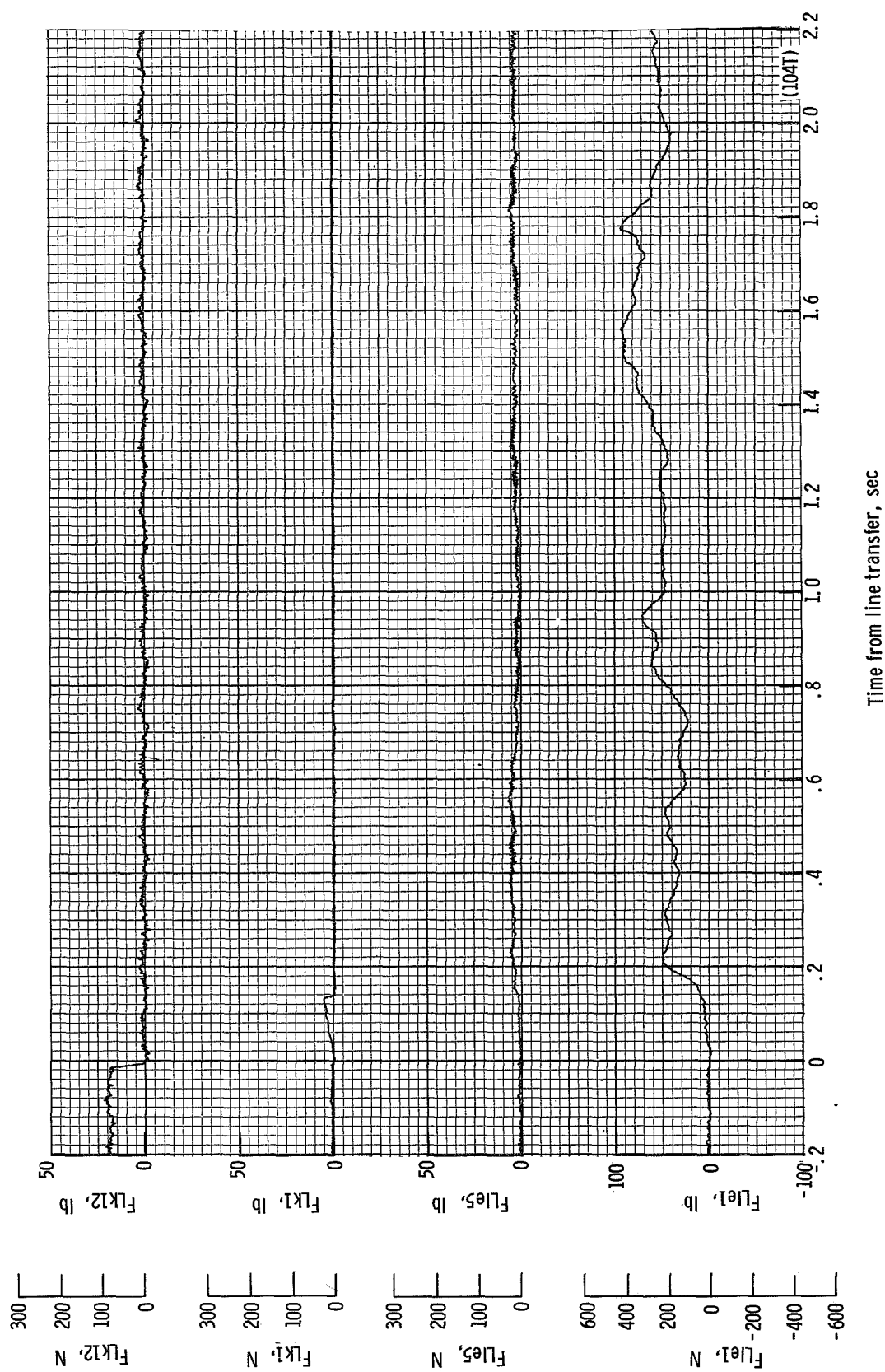
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 36.65 seconds after launch.

Figure 26.- Continued.



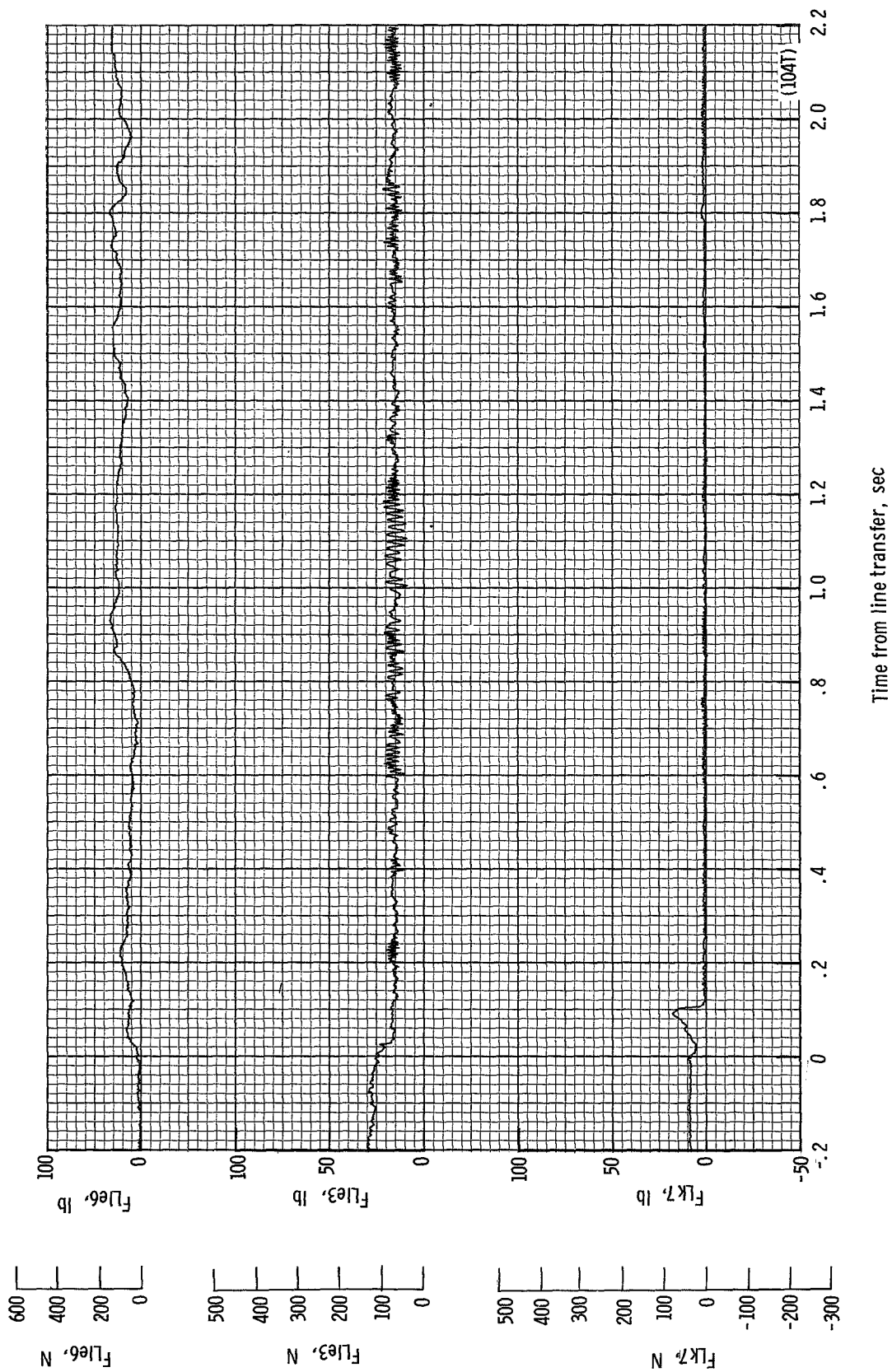
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 36.65 seconds after launch.

Figure 26.- Continued.



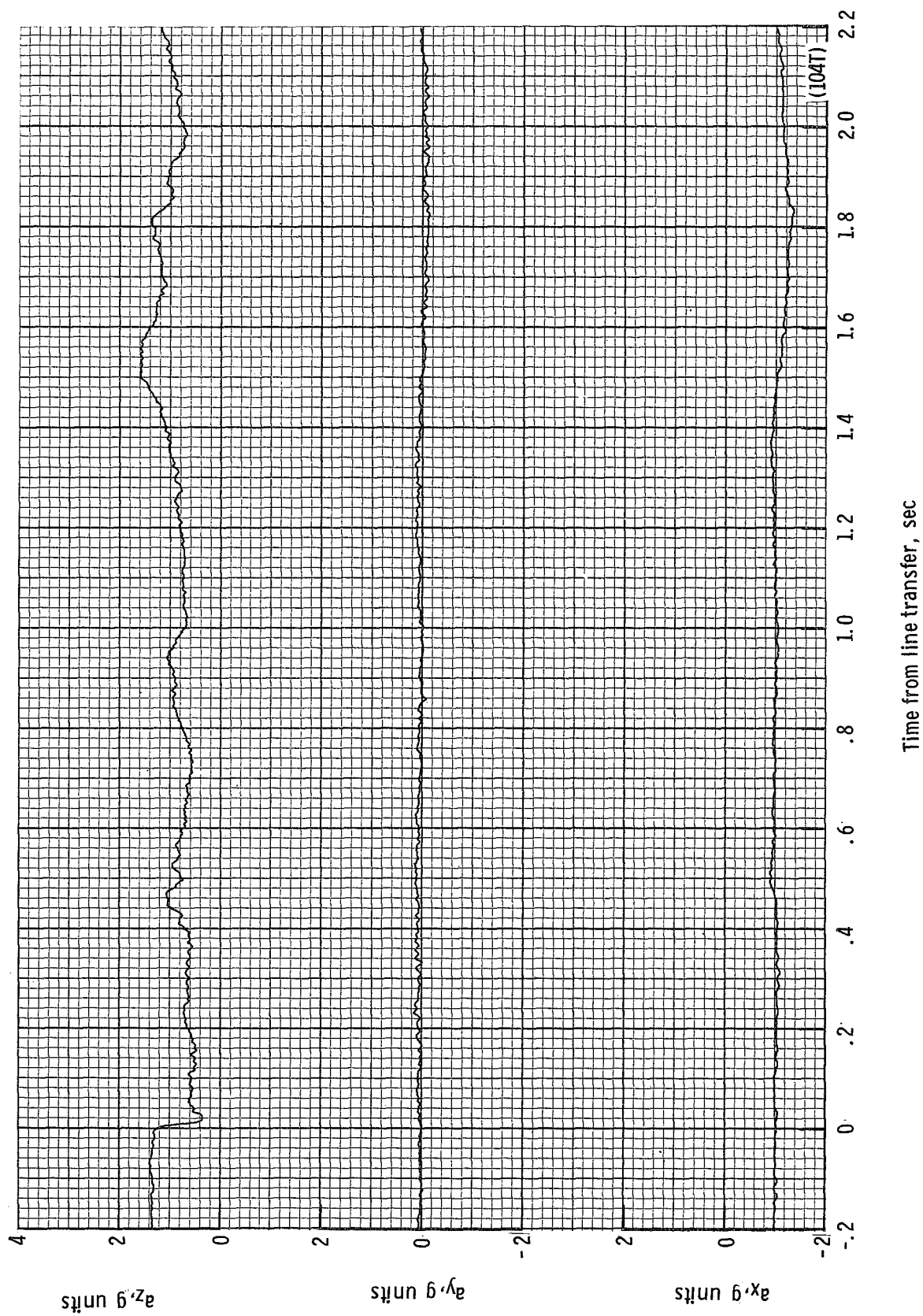
(u) Individual suspension-line loads F_{Lk1} , F_{Lk5} , F_{Lk1} , and F_{Lk12} plotted against time from line transfer. Time = 0 second corresponds to 33.72 seconds after launch.

Figure 26.- Continued.



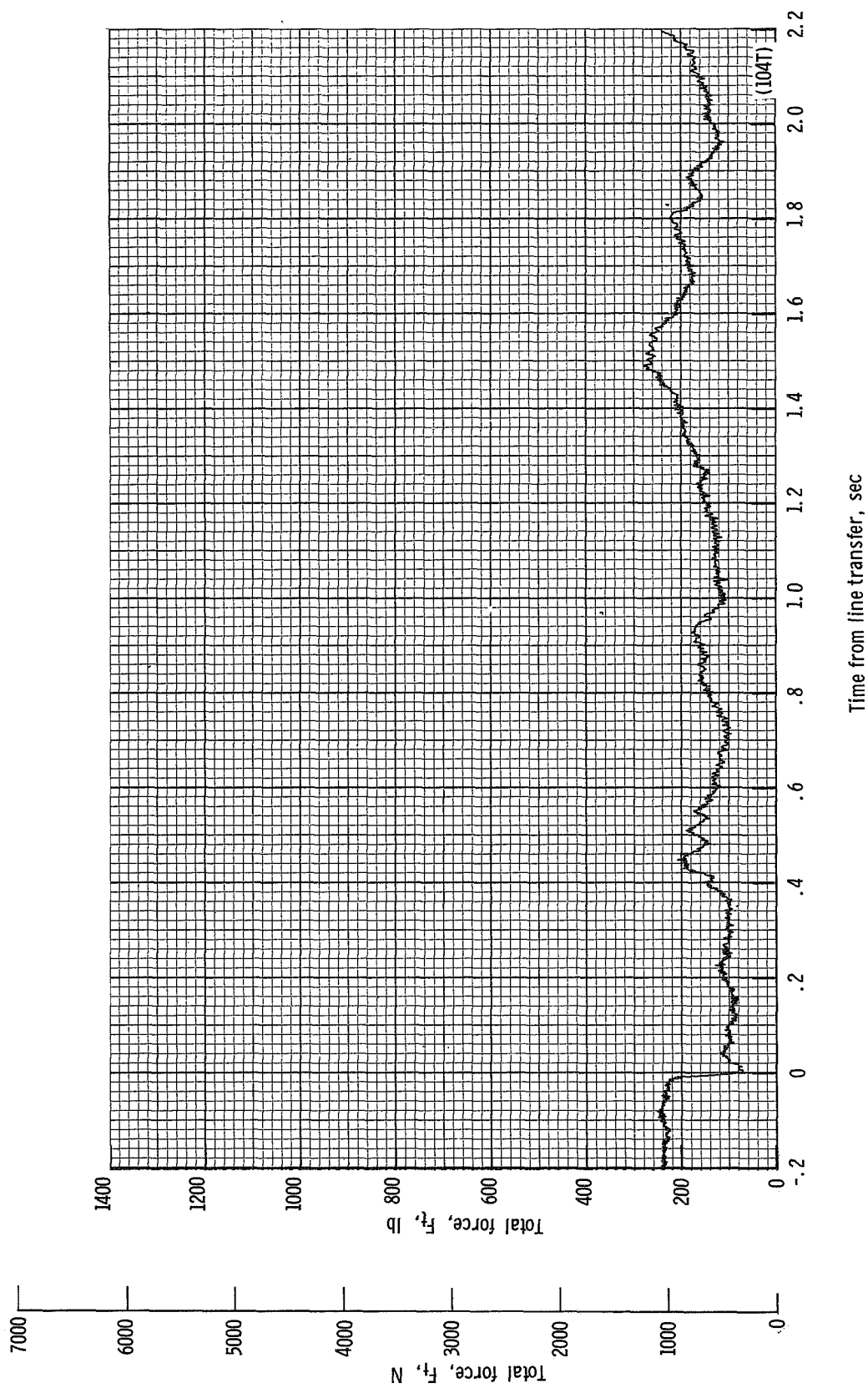
(v) Individual suspension-line loads F_{Lk7} , F_{Lle3} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 33.72 seconds after launch.

Figure 26.- Continued.



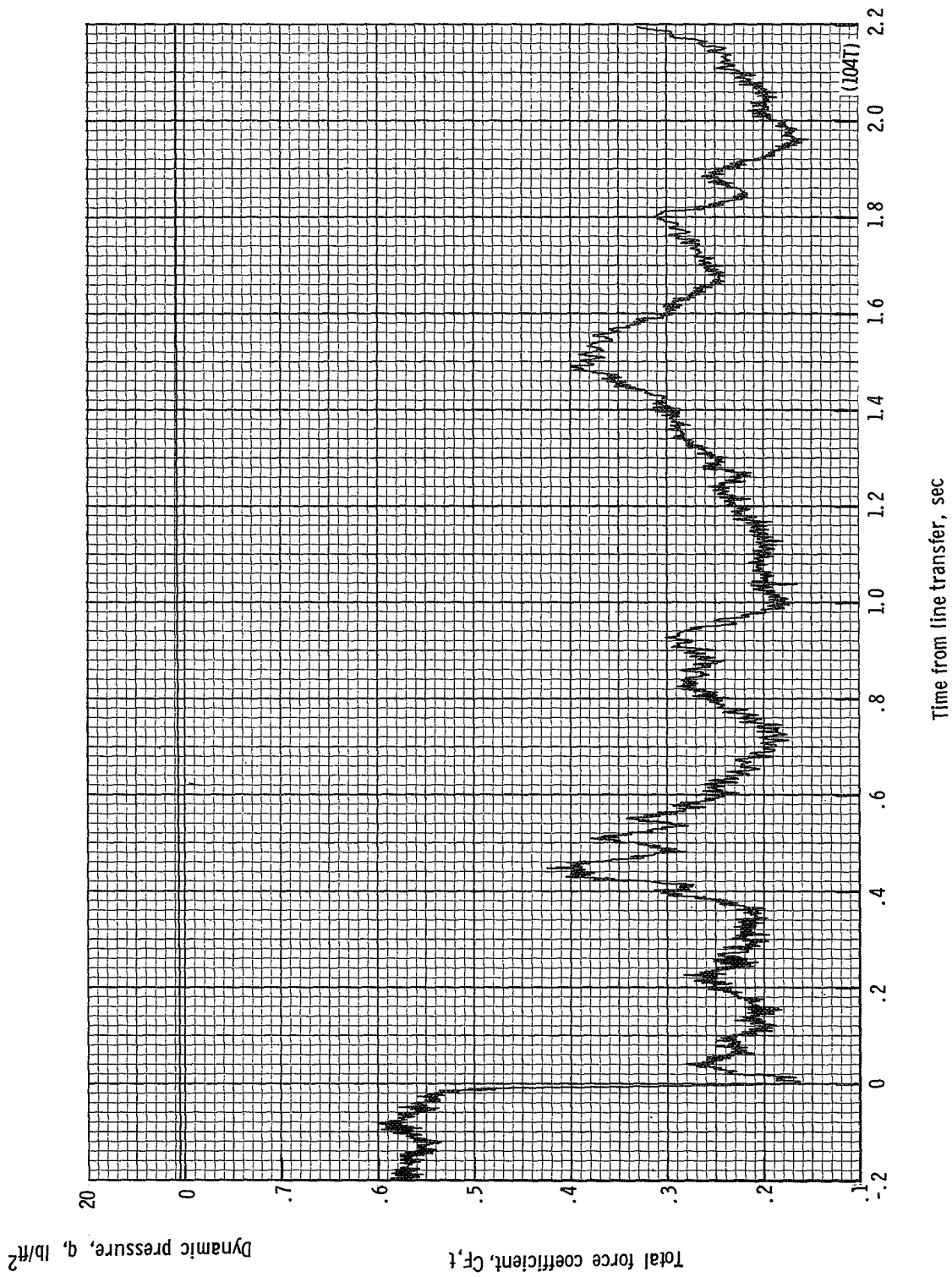
(w) Accelerations a_x , a_y , and a_z plotted against time from line transfer. Time = 0 second corresponds to 33.72 seconds after launch.

Figure 26.- Continued.



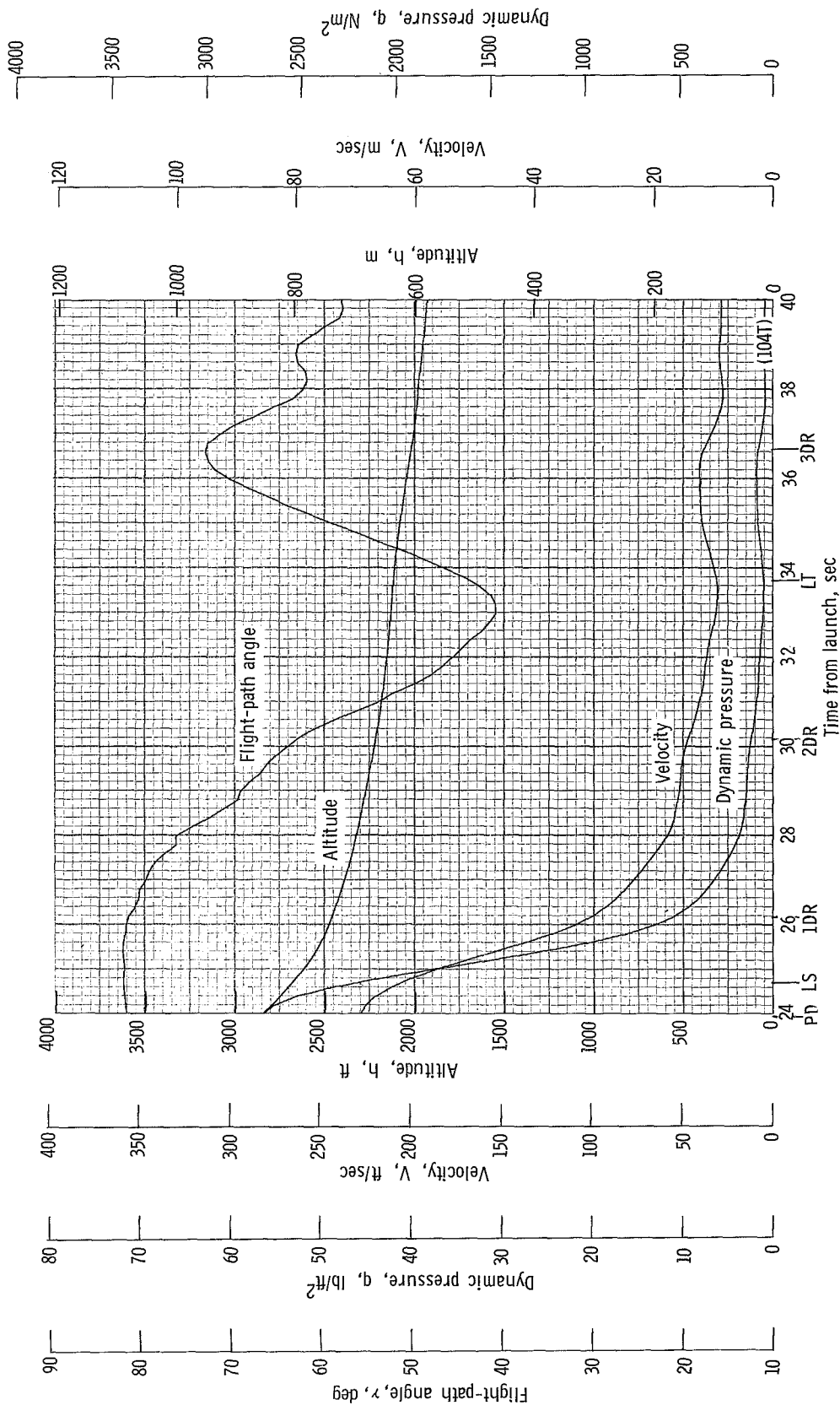
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 33.72 seconds after launch.

Figure 26.- Continued.



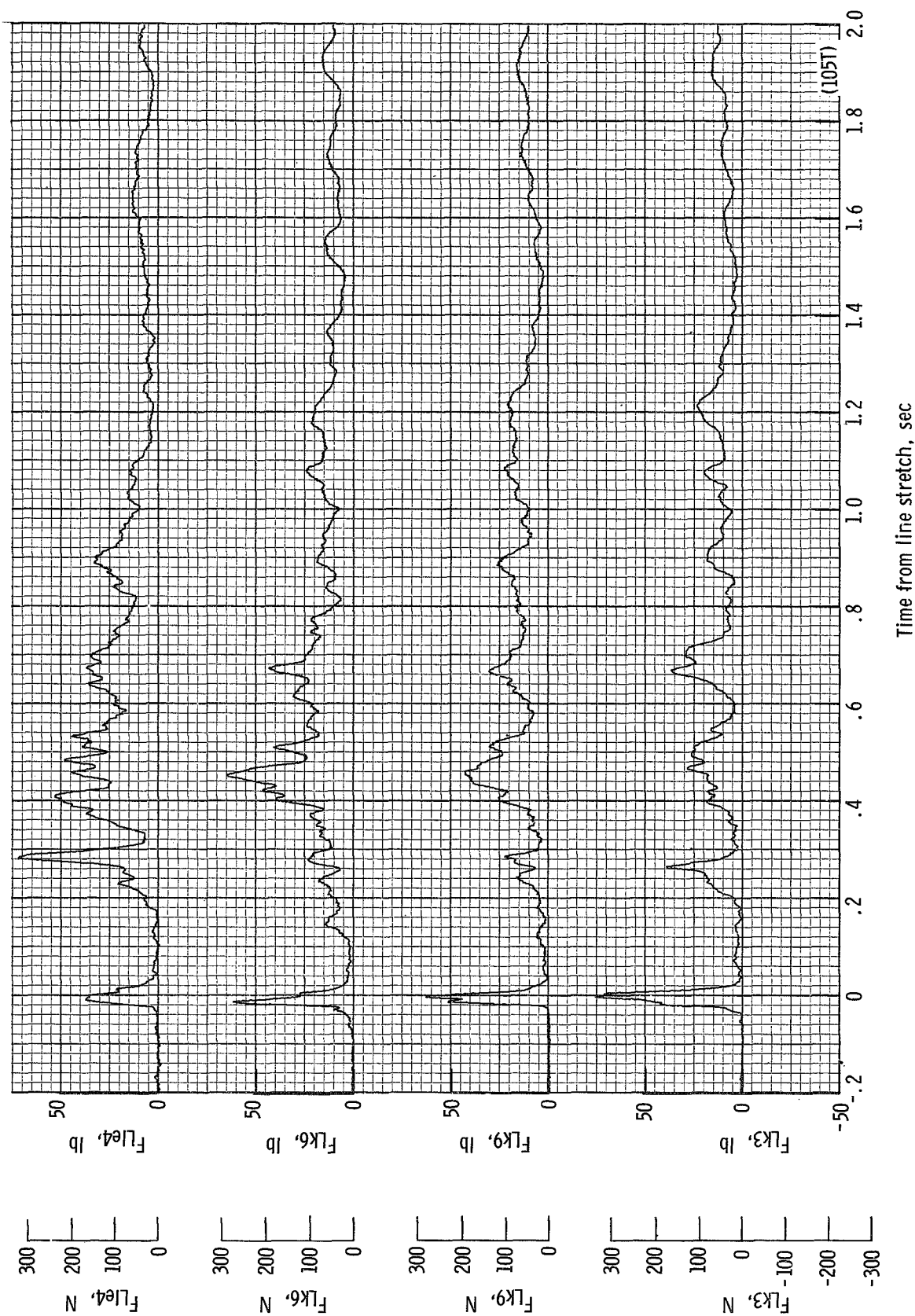
(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 33.72 seconds after launch.

Figure 26.- Continued.



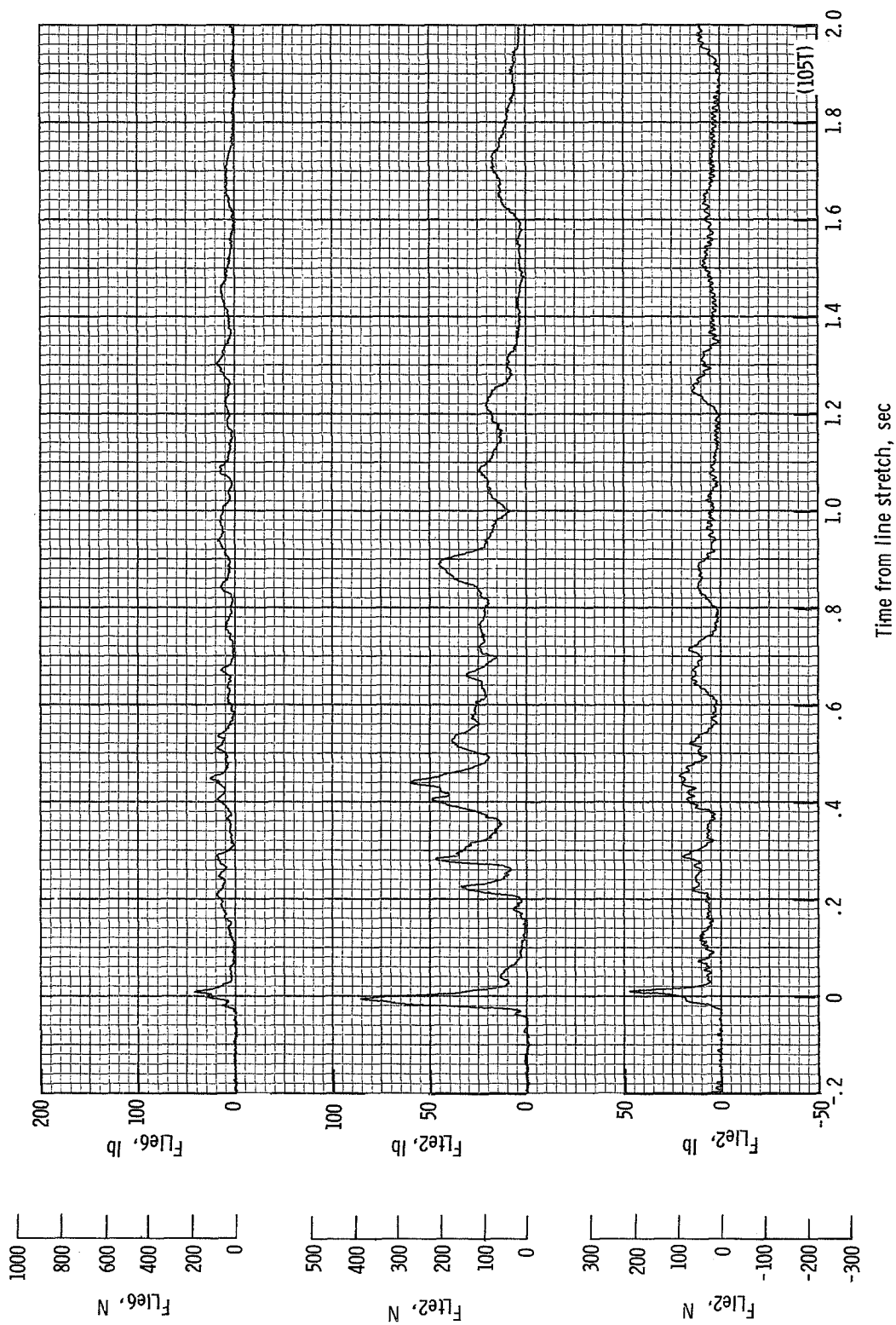
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch. PD occurs at 23.93 sec.

Figure 26.- Concluded.



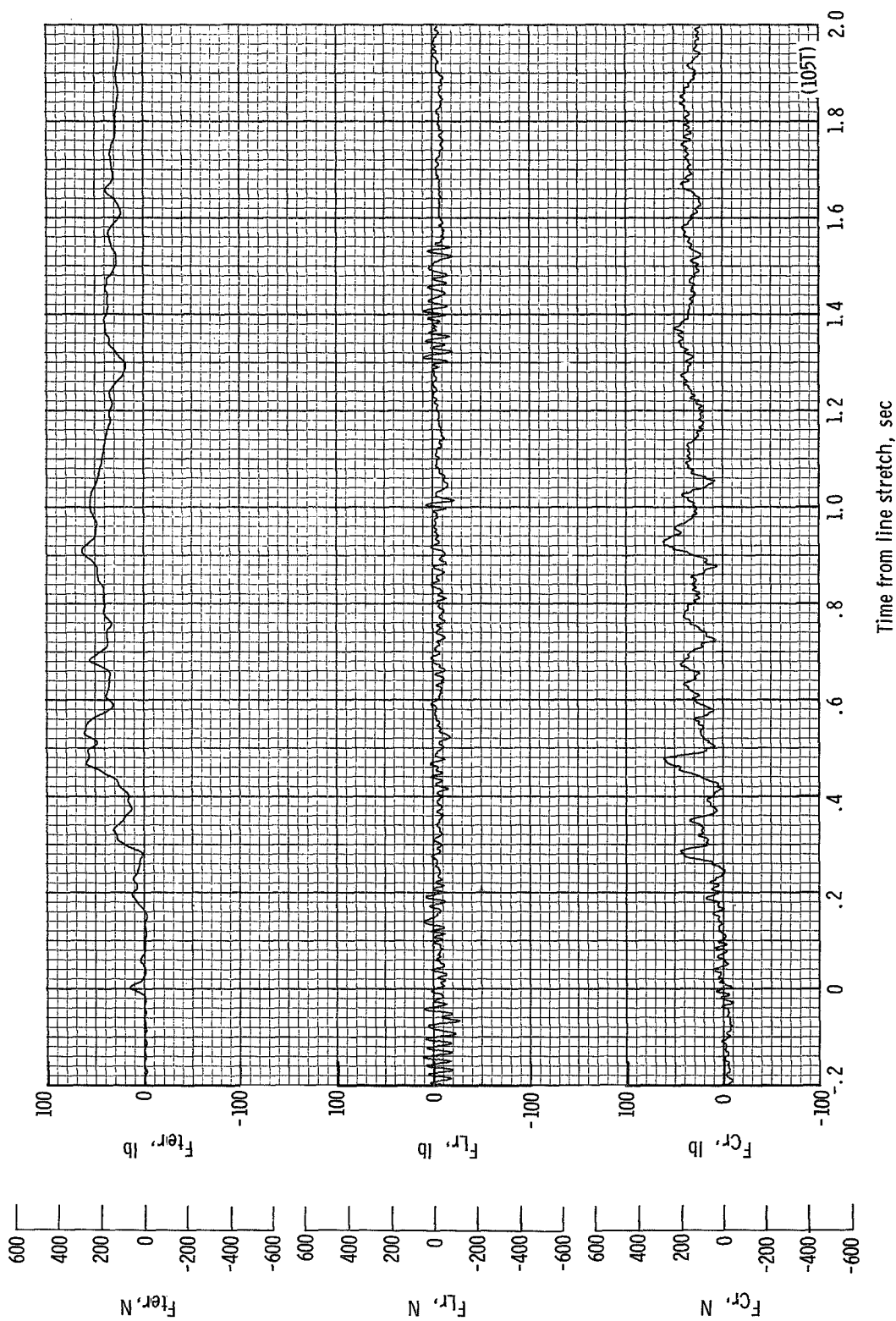
(a) Individual suspension-line loads F_{LK3} , F_{LK6} , F_{LK9} and F_{LLe4} plotted against time from line stretch. Time = 0 second corresponds to 24.59 seconds after launch.

Figure 27.- Time history of twin-keel parawing deployment data for test 105T. $W_D = 1137.9$ N (255.8 lb); $W_P = 973.3$ N (218.8 lb); $q_{PD} = 2164.2$ N/m² (45.2 lb/ft²); $h_{PD} = 1095$ m (3591 ft); $L_T/L_K = 0.141$; reefing version 1.



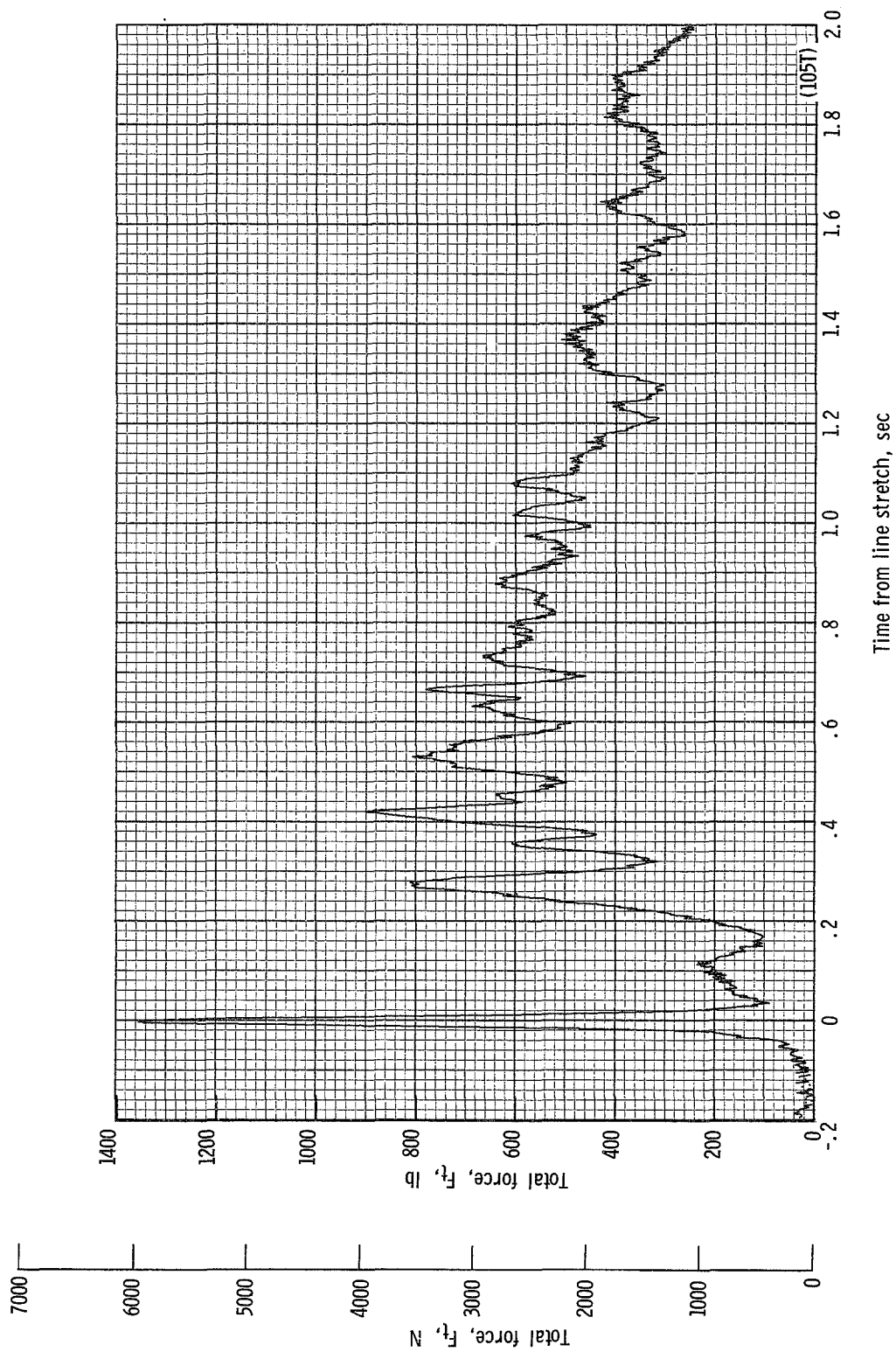
(b) Individual suspension-line loads F_{Lle2} , F_{Lte2} , and F_{Lle6} plotted against time from line stretch. Time = 0 second corresponds to 24.59 seconds after launch.

Figure 27.- Continued.



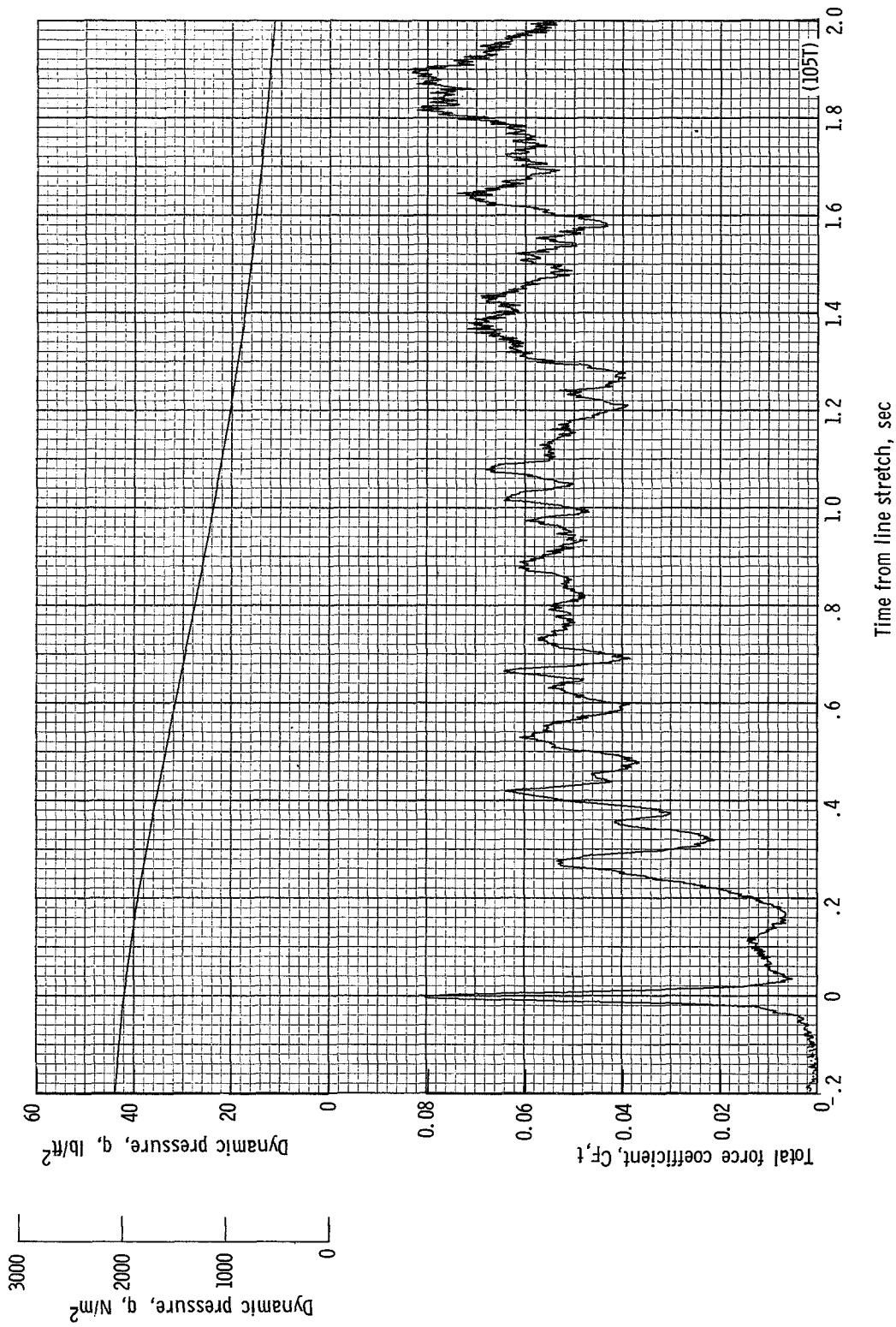
(c) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Ter} plotted against time from line stretch. Time = 0 second corresponds to 24.59 seconds after launch.

Figure 27.- Continued.



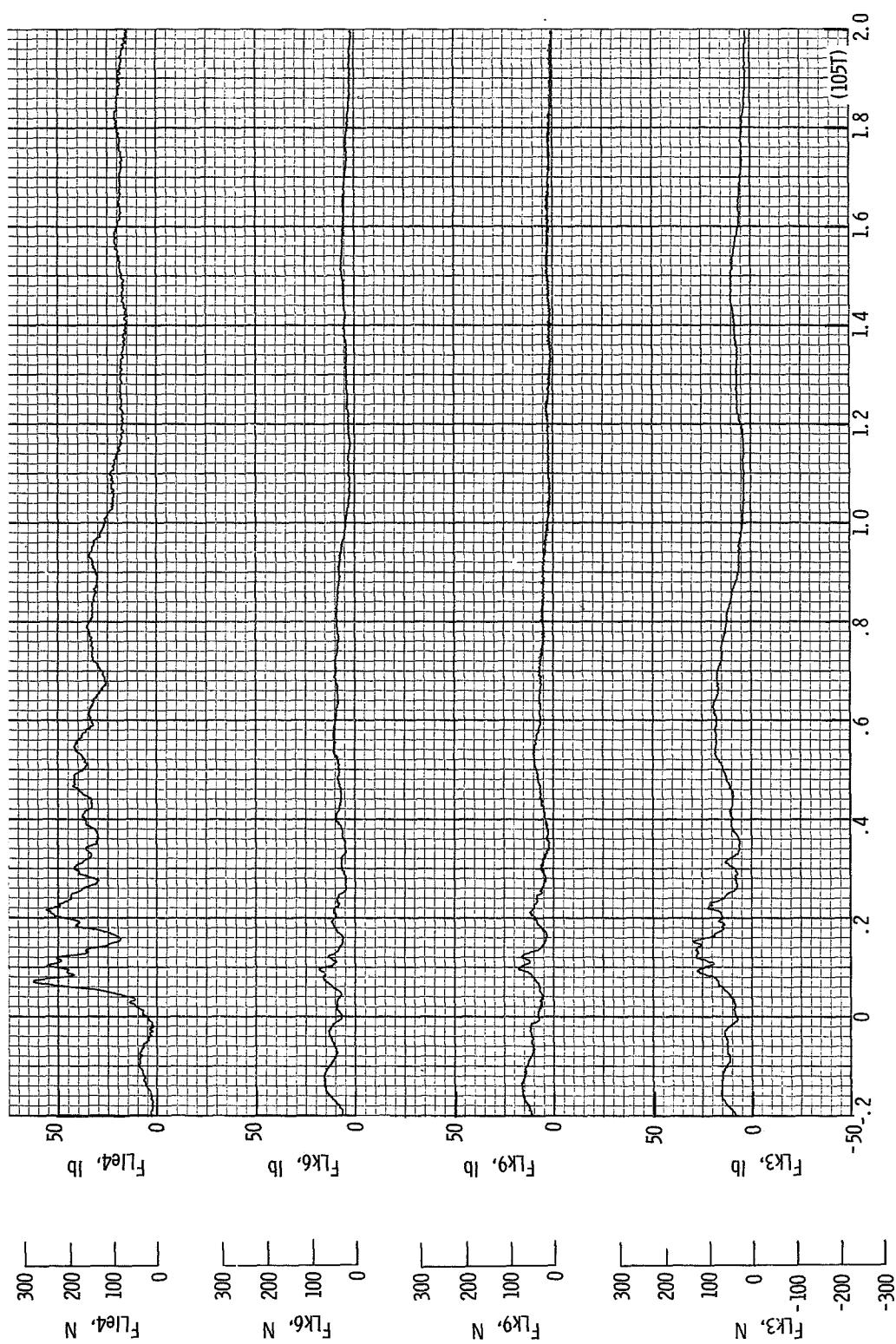
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 24.59 seconds after launch.

Figure 27.- Continued.



(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 24.59 seconds after launch.

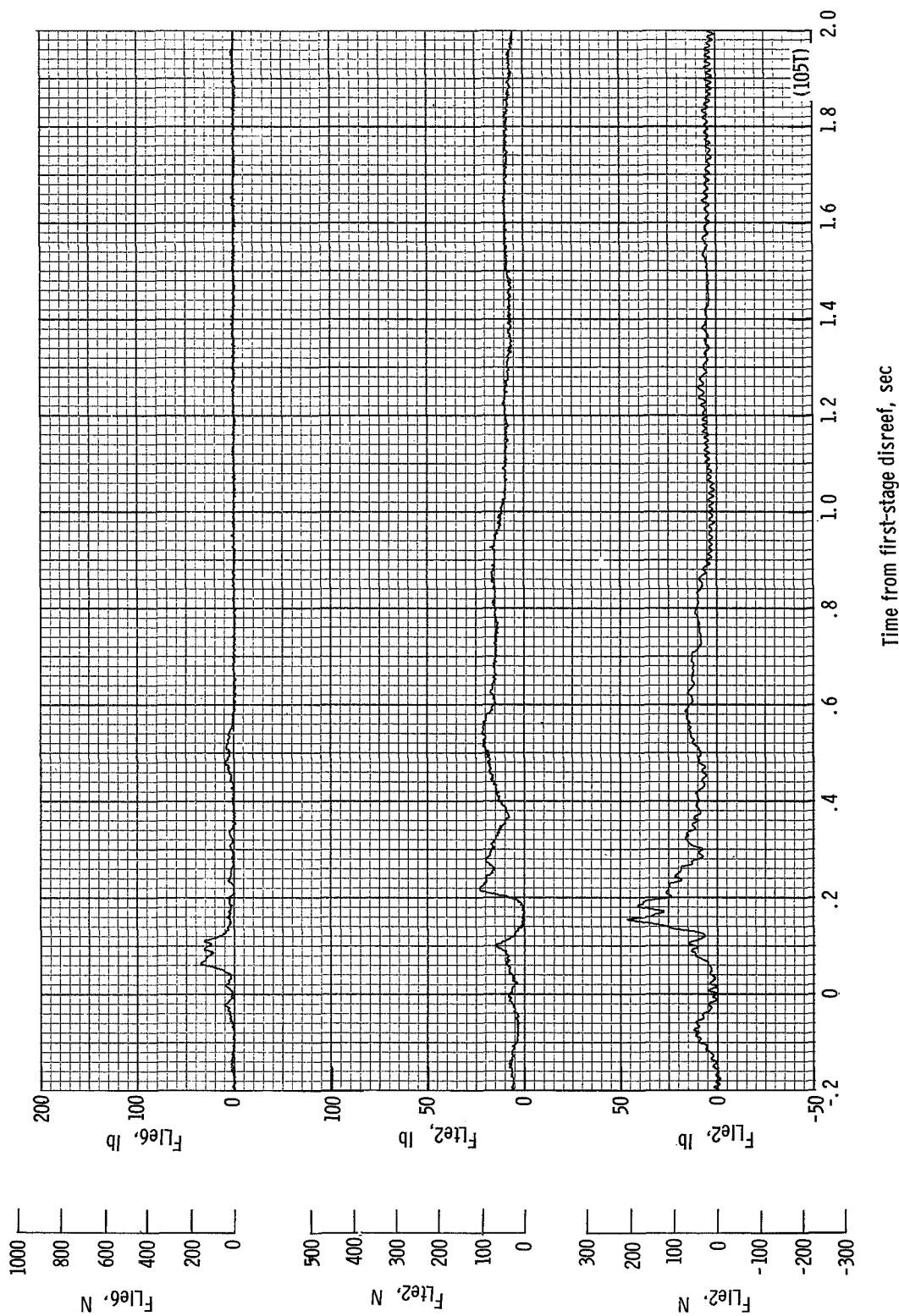
Figure 27.- Continued.



Time from first-stage disreef, sec

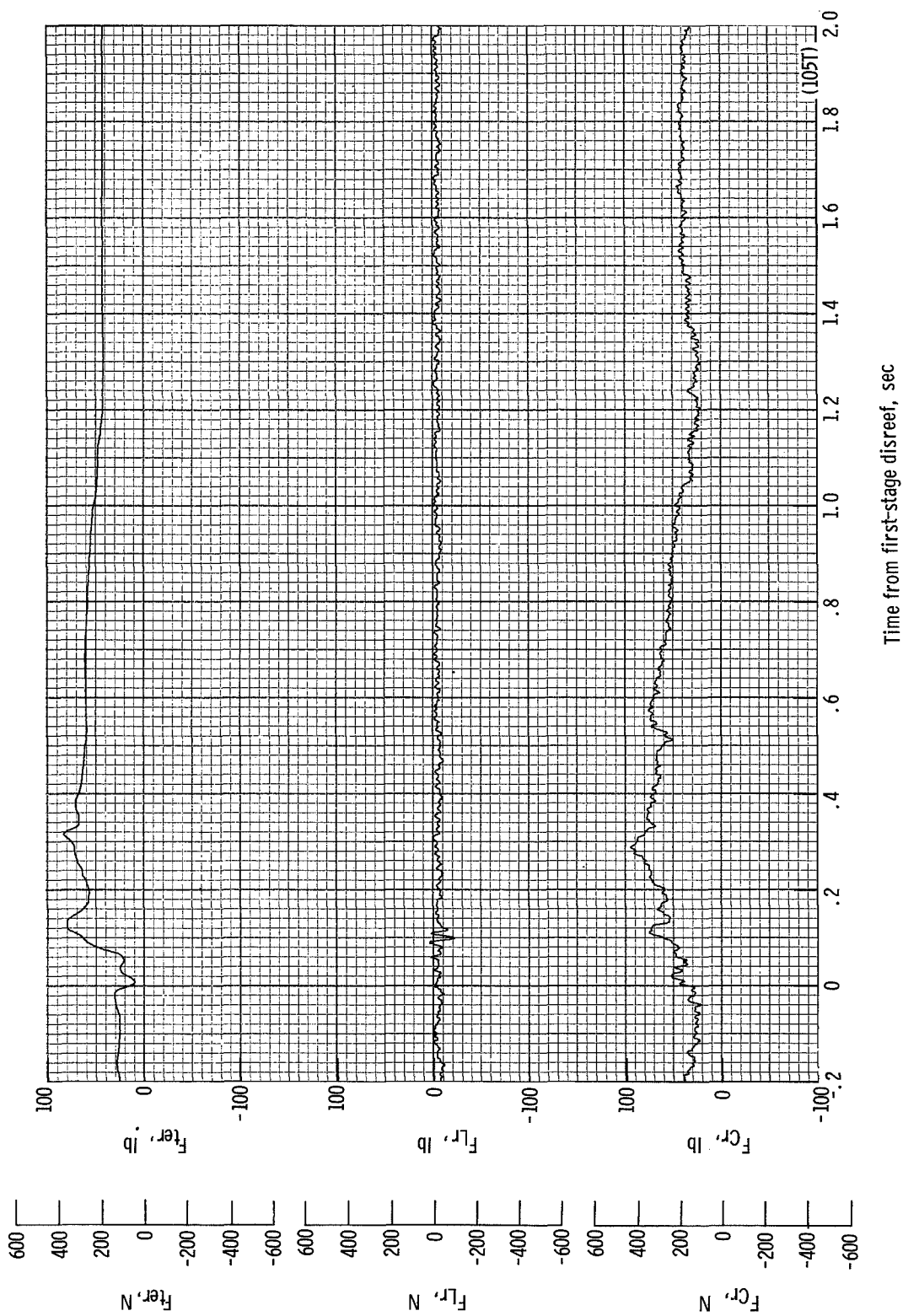
(f) Individual suspension-line loads F_{Lk3} , F_{Lk9} , F_{Lk6} , and F_{Lle4} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.62 seconds after launch.

Figure 27.- Continued.



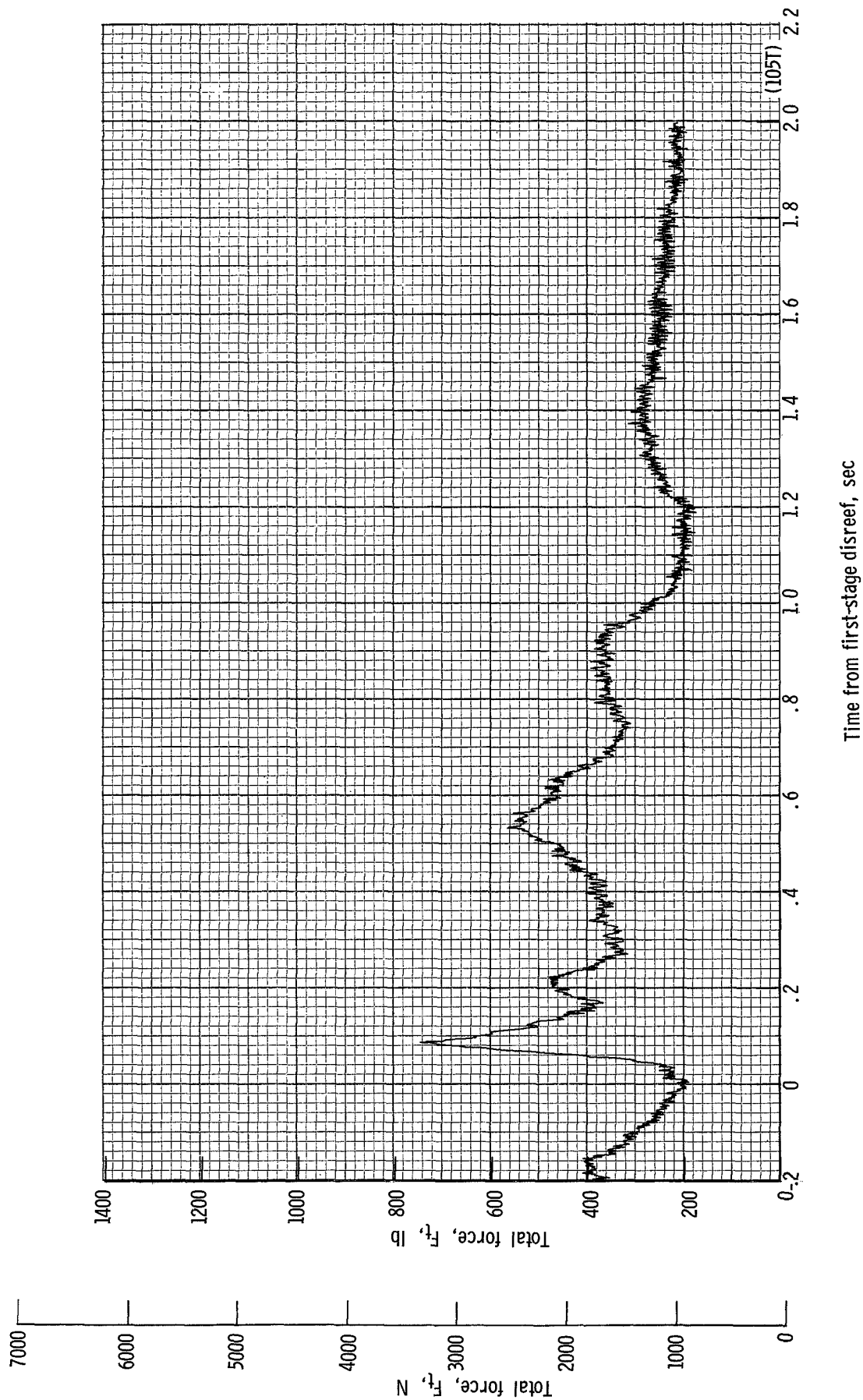
(g) Individual suspension-line loads F_{Lie2} , F_{Lie6} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.62 seconds after launch.

Figure 27.- Continued.



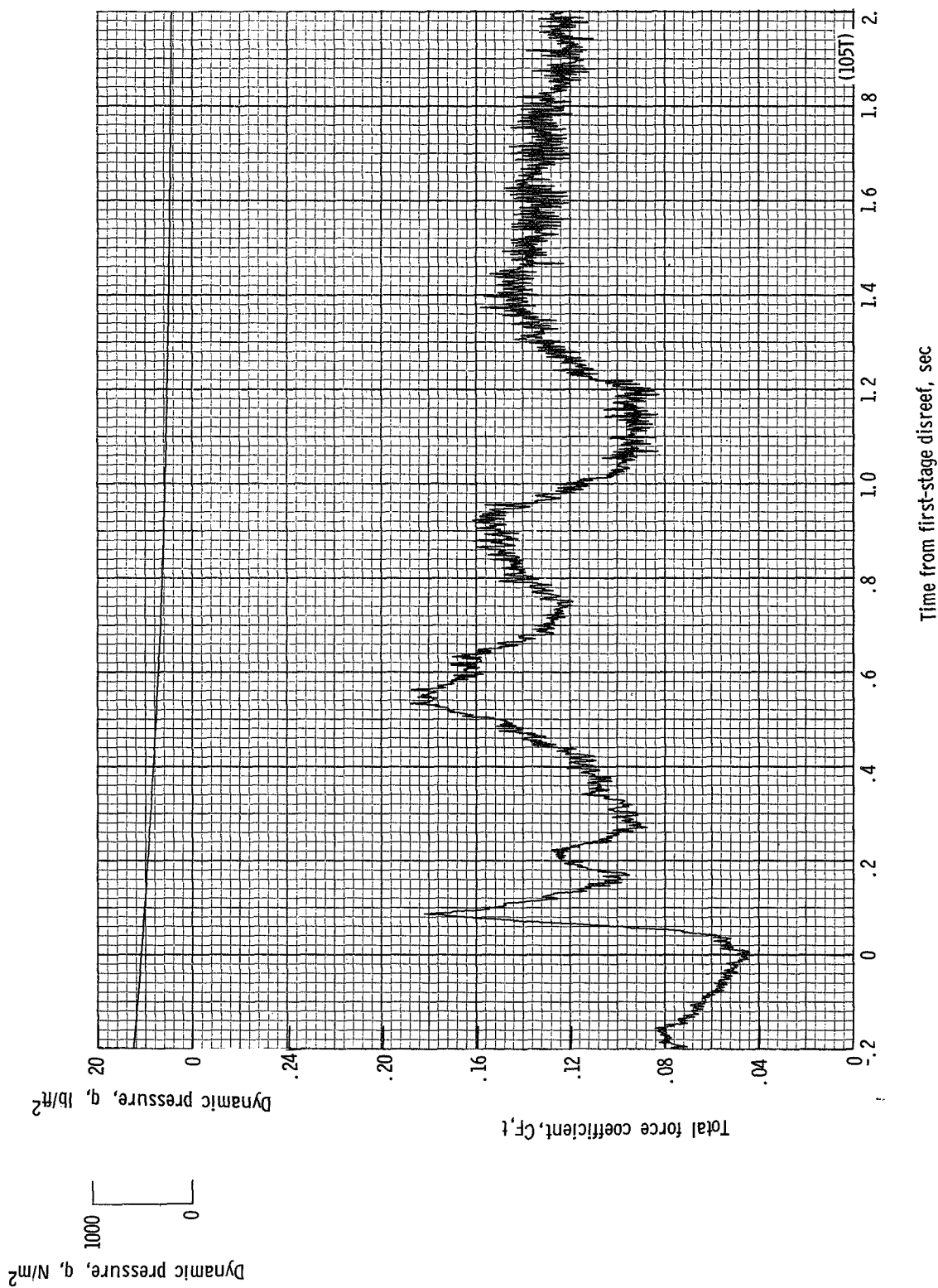
(h) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Ter} plotted against time from first-stage disreef. Time = 0 second corresponds to 26.62 seconds after launch.

Figure 27.- Continued.



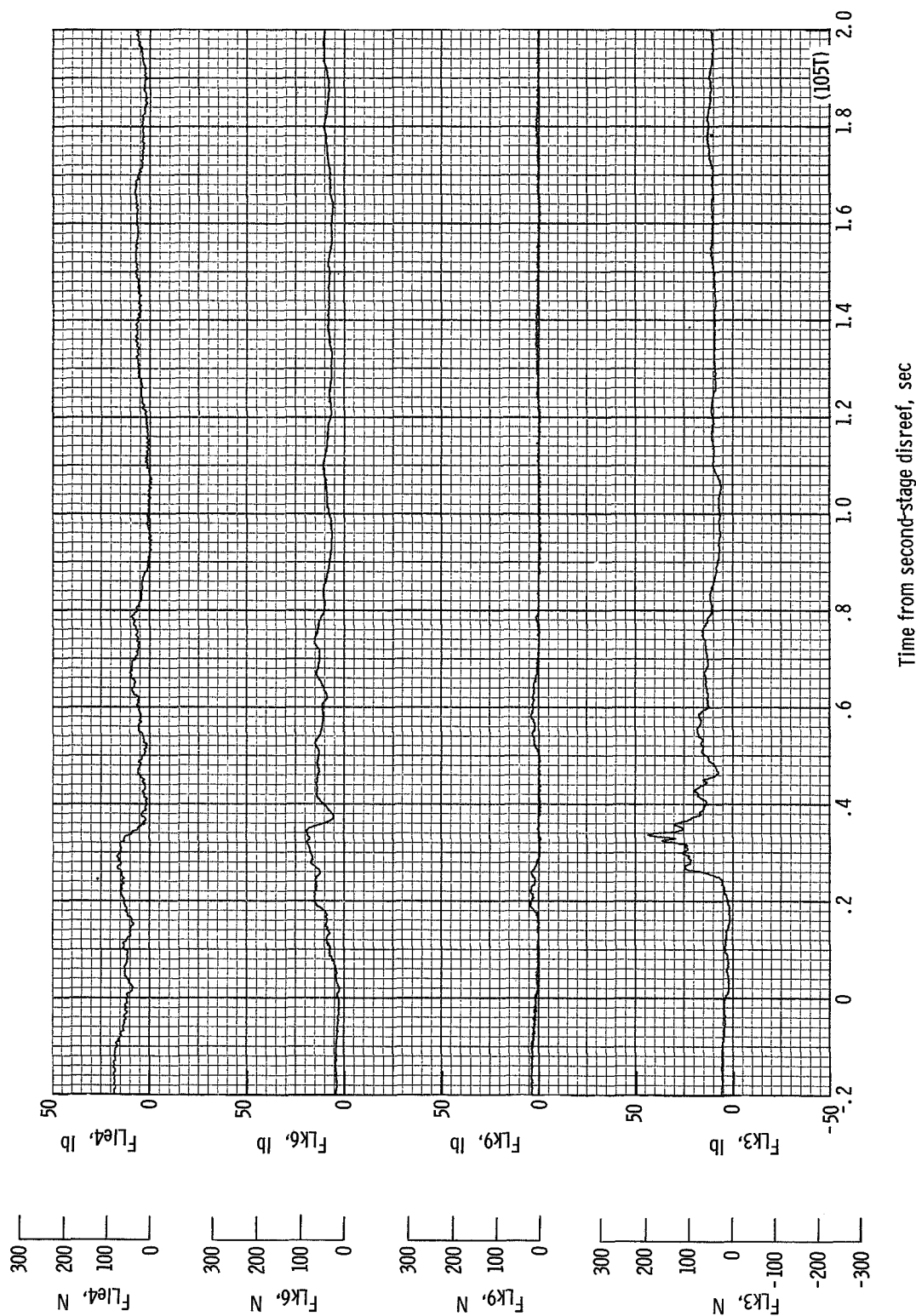
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 26.62 seconds after launch.

Figure 27.- Continued.



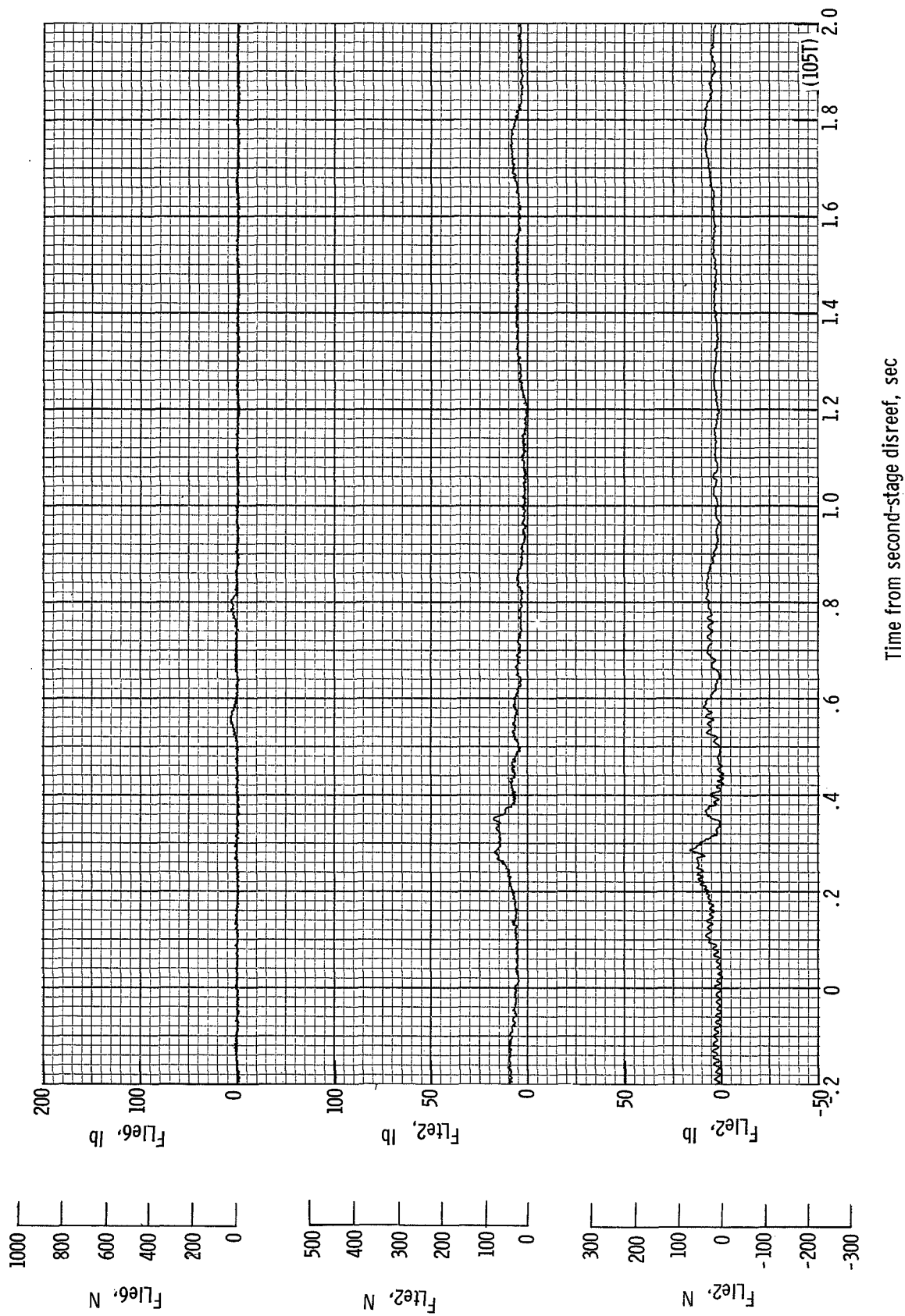
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 26.62 seconds after launch.

Figure 27.- Continued.



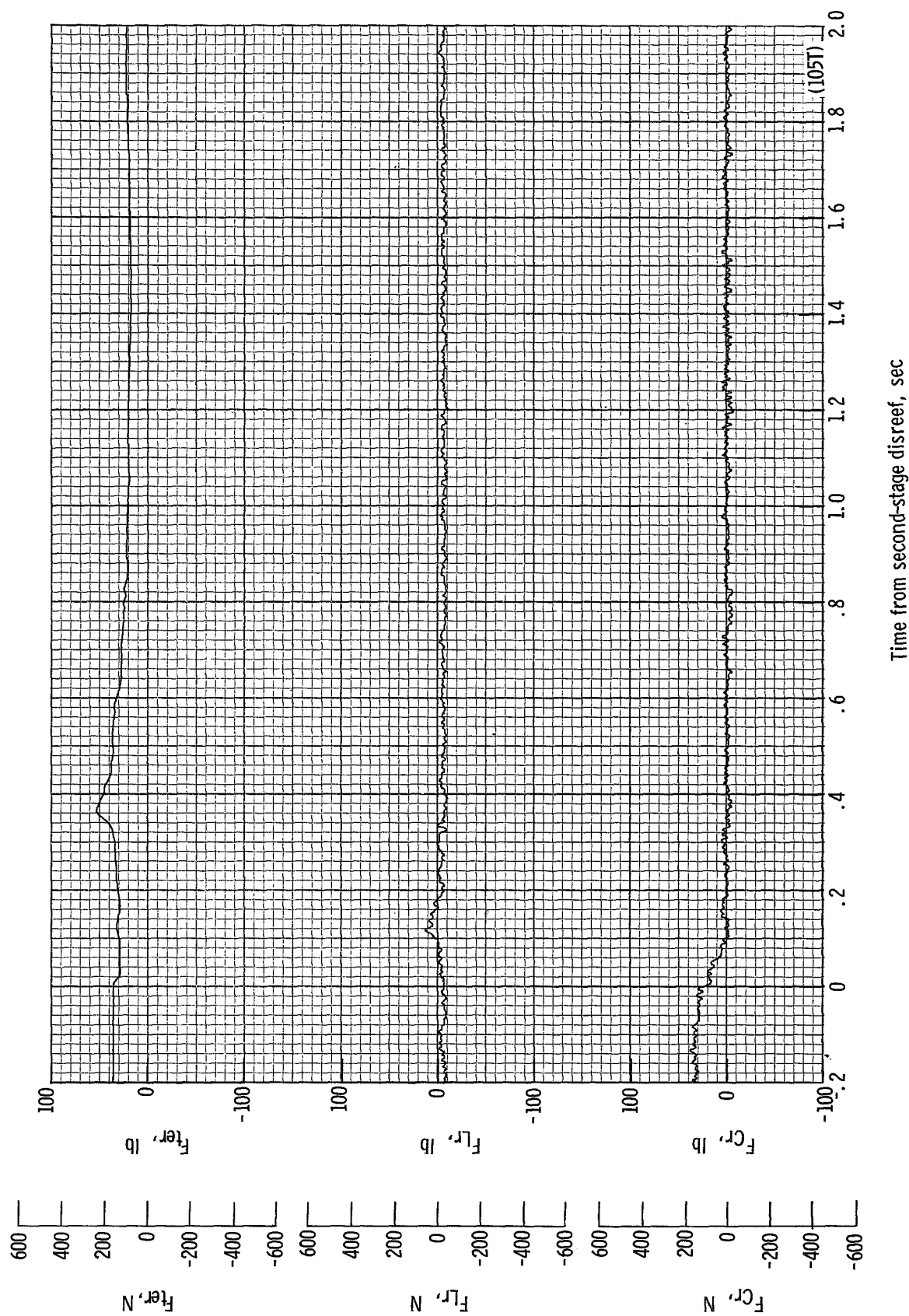
(k) Individual suspension-line loads F_{LK3} , F_{LK9} , F_{LK6} and F_{LK4} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.33 seconds after launch.

Figure 27.- Continued.



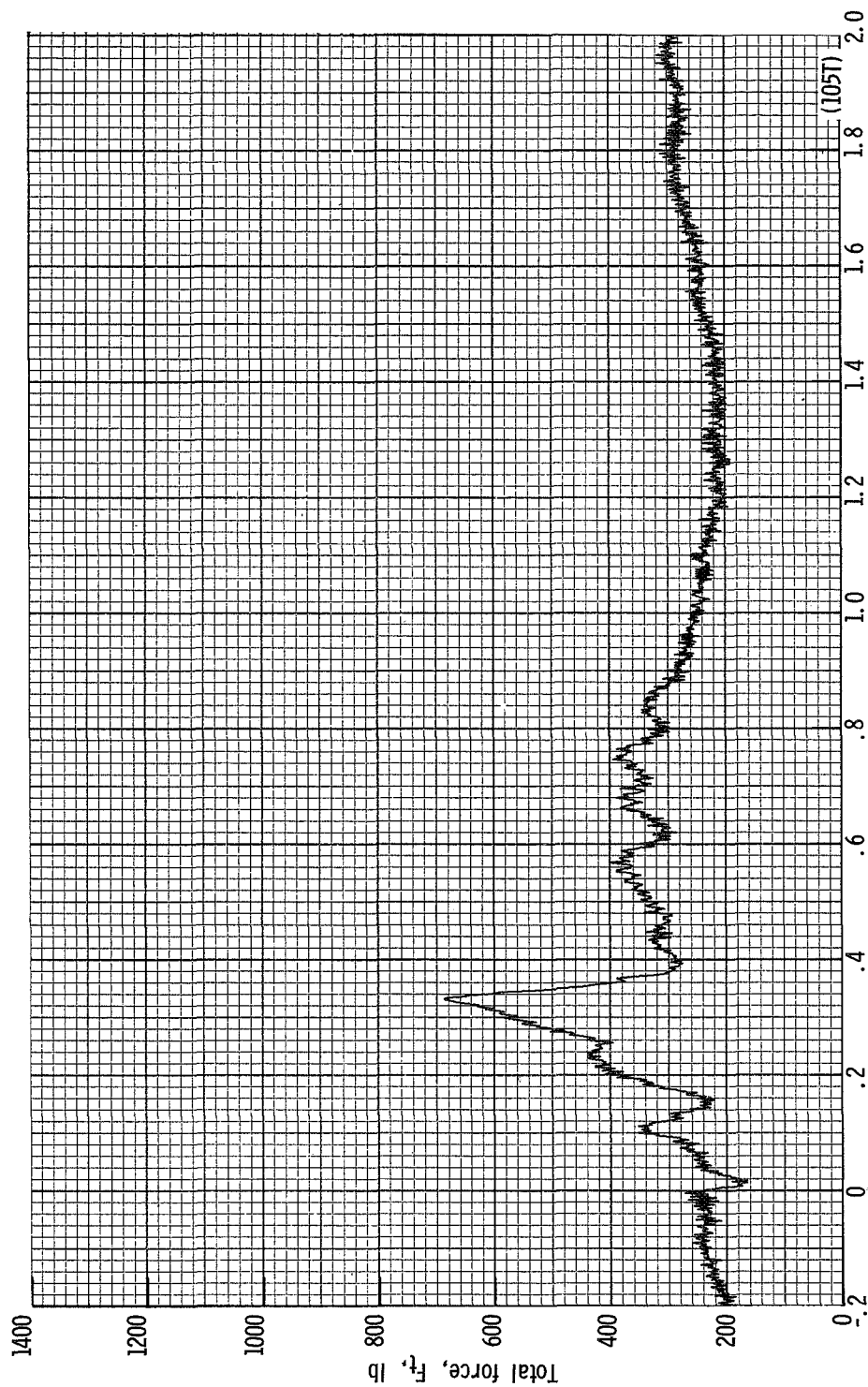
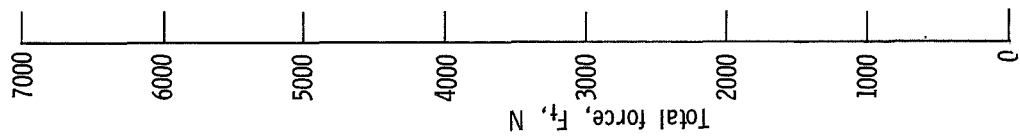
(1) Individual suspension-line loads F_{Lie6} , F_{Lie2} , and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.33 seconds after launch.

Figure 27.- Continued.



(m) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Tr} plotted against time from second-stage disreef. Time = 0 second corresponds to 30.33 seconds after launch.

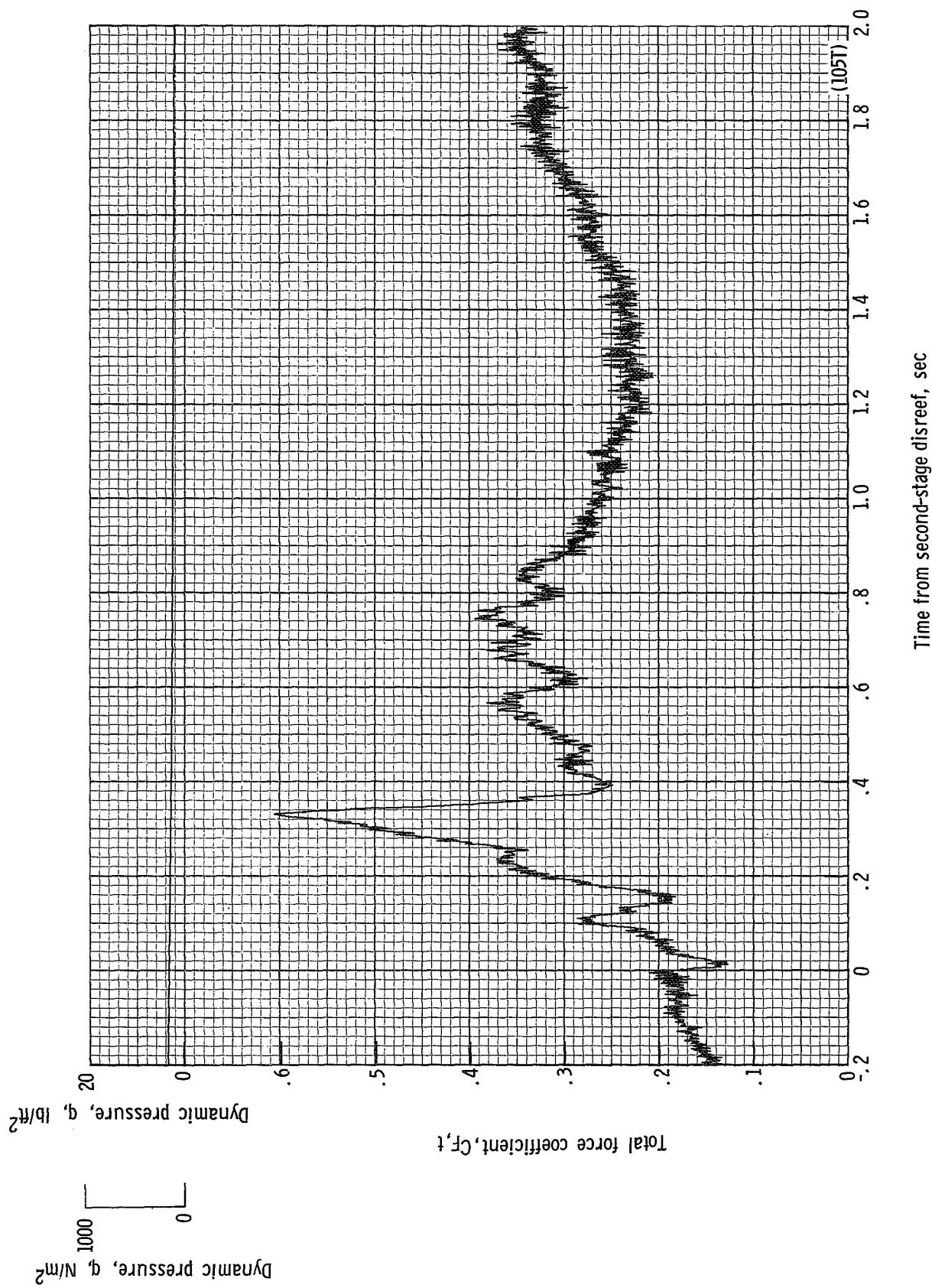
Figure 27.- Continued.



Time from second-stage disreef, sec

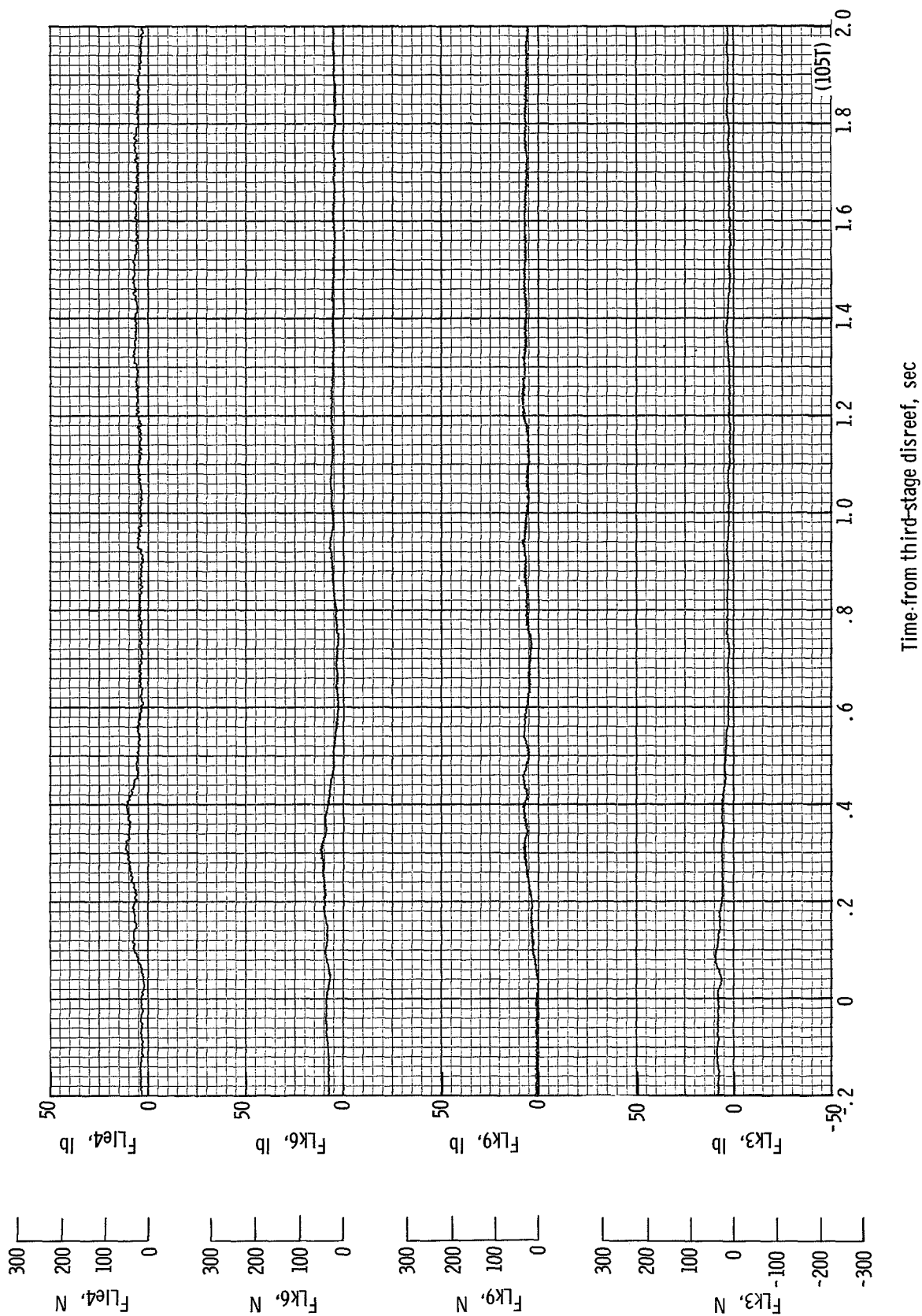
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 30.33 seconds after launch.

Figure 27.- Continued.



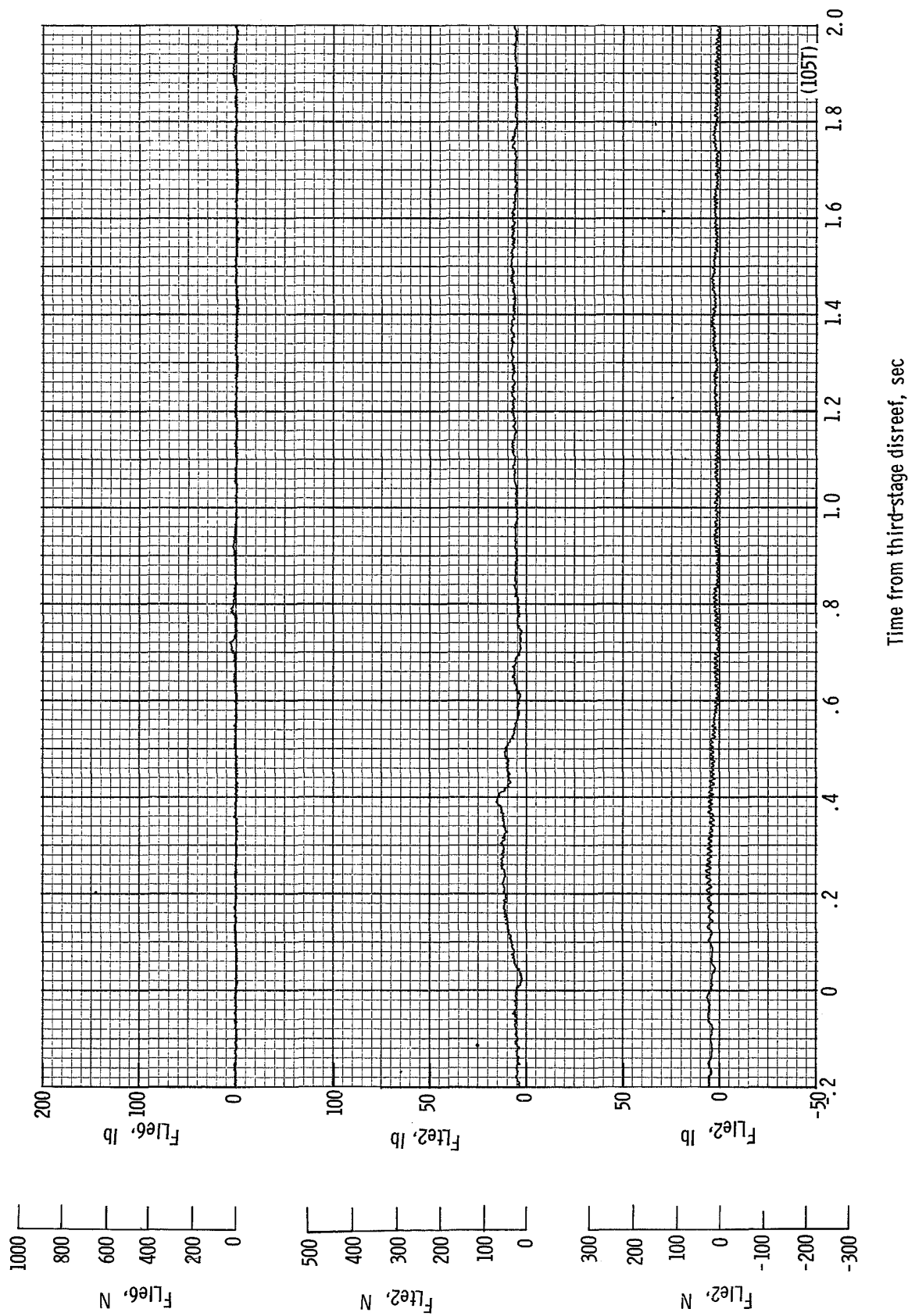
(a) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 30.33 seconds after launch.

Figure 27.- Continued.



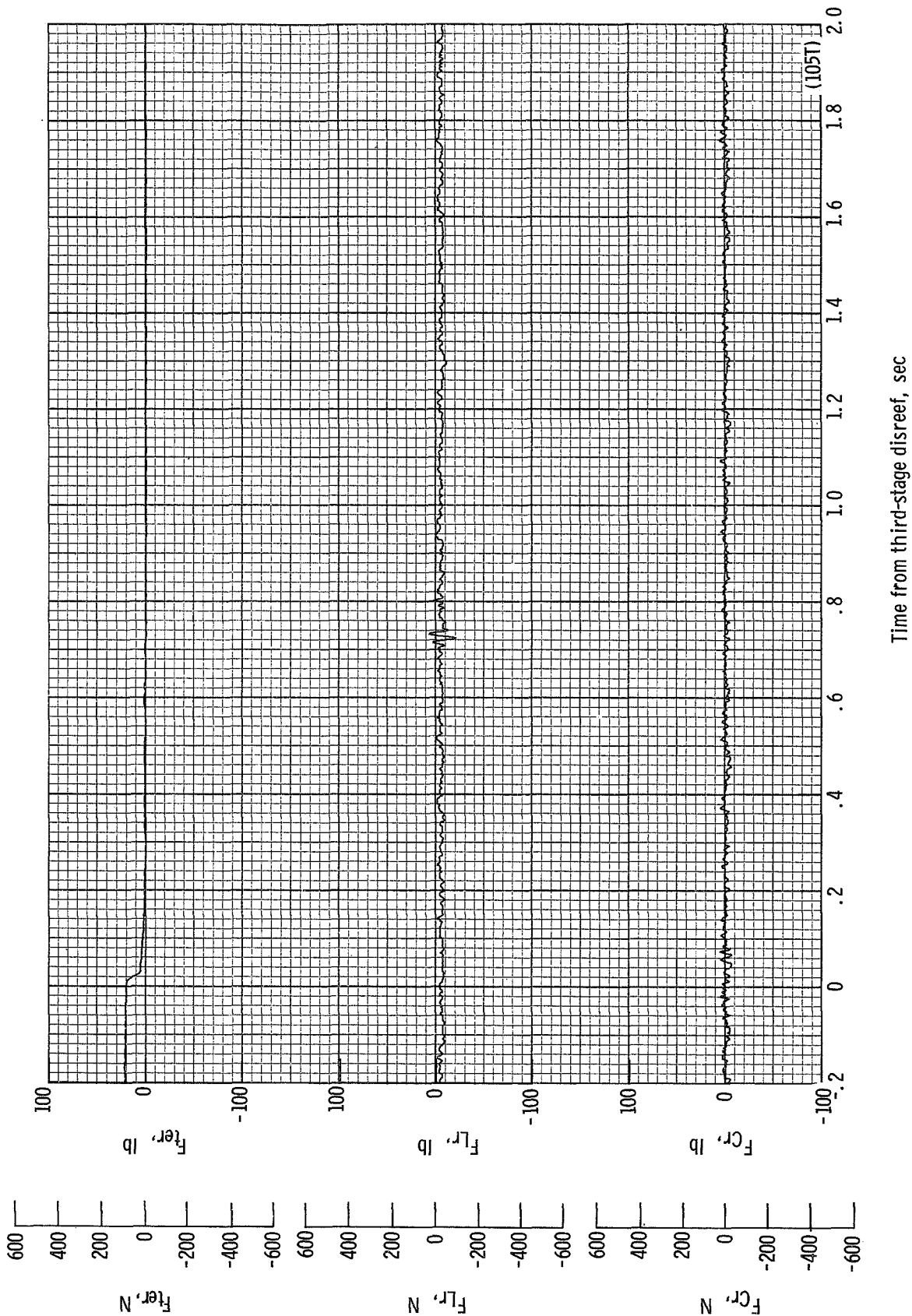
(p) Individual suspension-line loads FLK_3 , FLK_6 , FLK_9 and $FLie_4$ plotted against time from third-stage disreef. Time = 0 second corresponds to 33.55 seconds after launch.

Figure 27.- Continued.



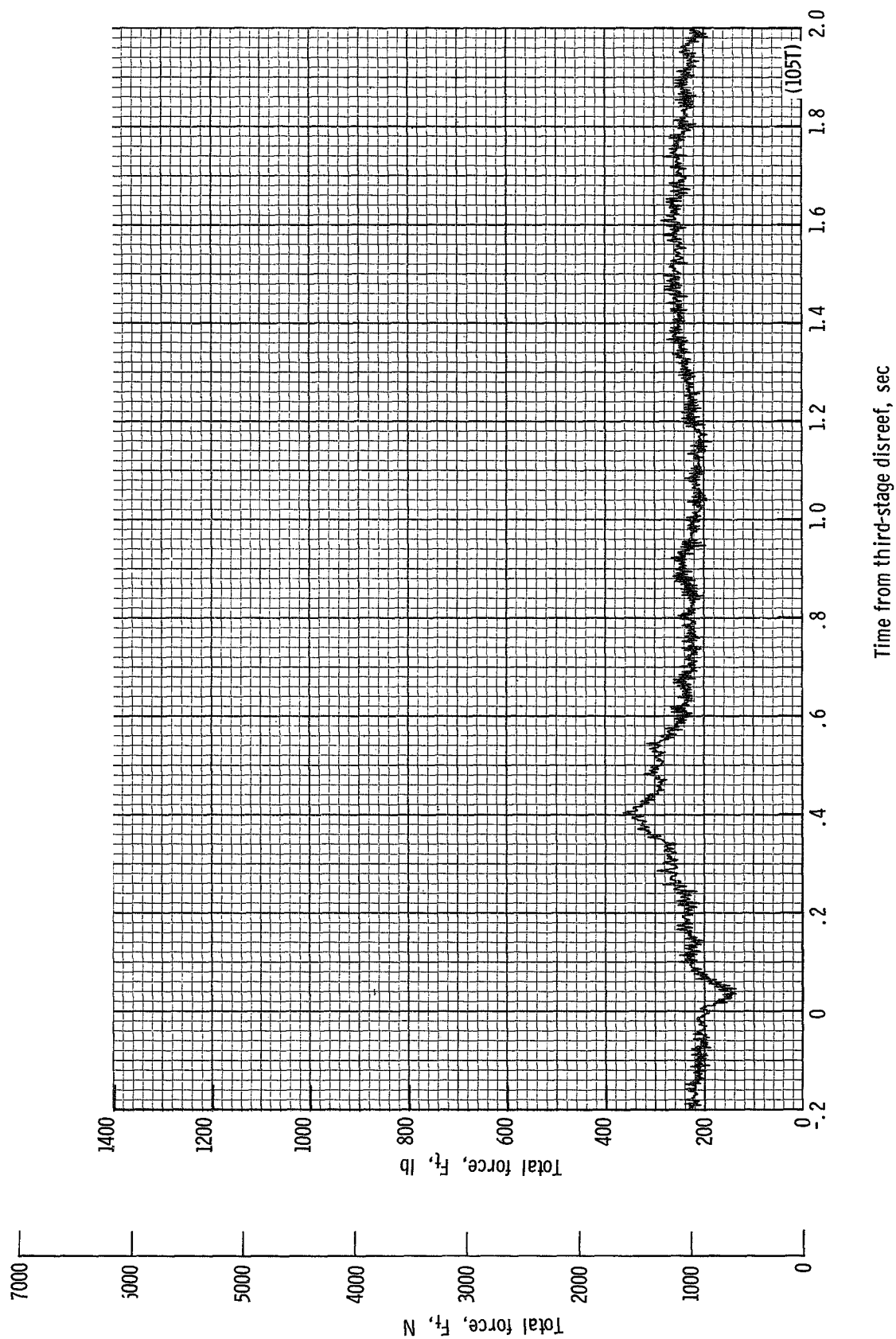
(q) Individual suspension-line loads F_{Lie2} , F_{Lie6} plotted against time from third-stage disreef. Time = 0 second corresponds to 33.55 seconds after launch.

Figure 27.- Continued.



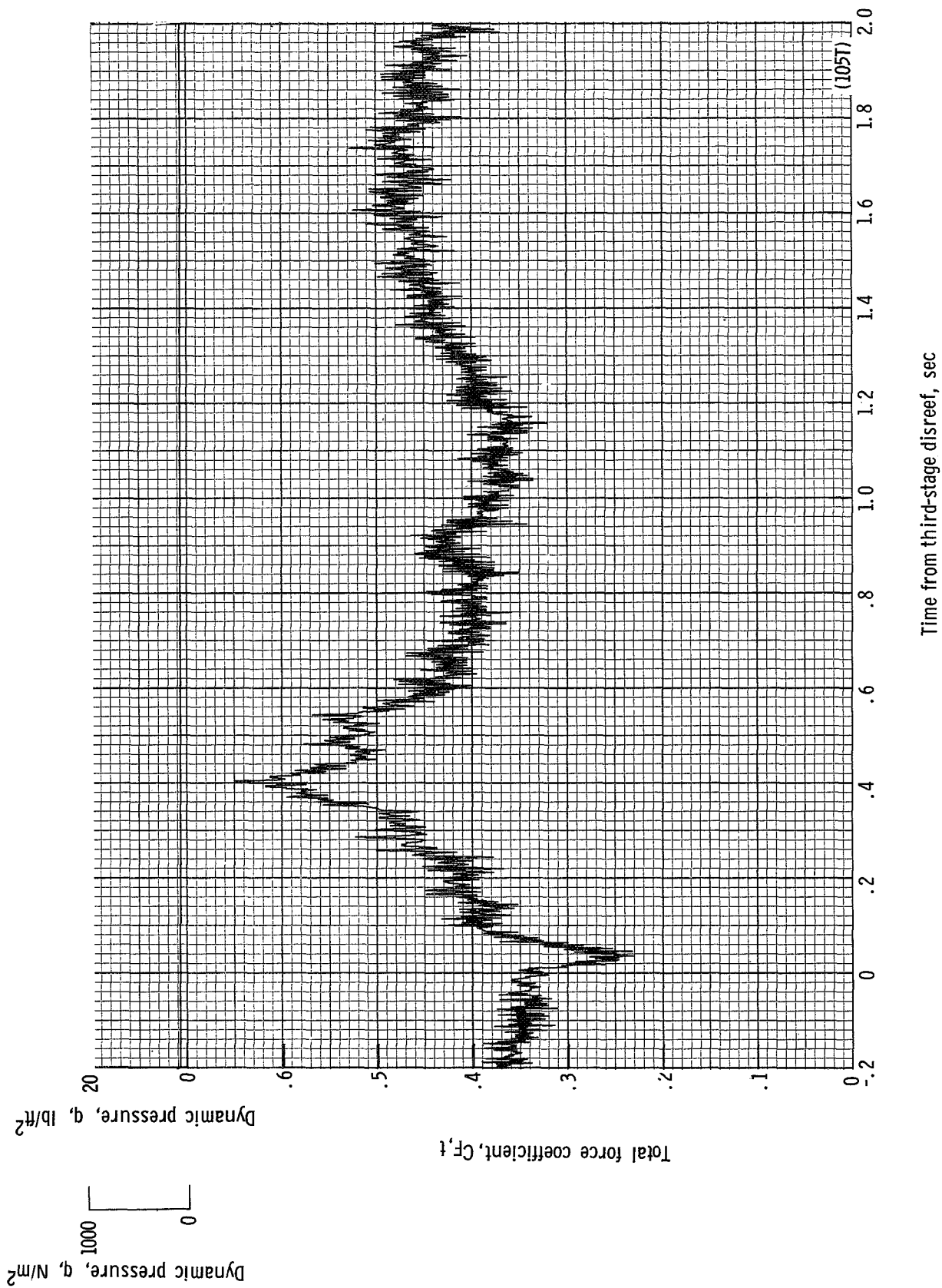
(r) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Tr} plotted against time from third-stage disreef. Time = 0 second corresponds to 33.55 seconds after launch.

Figure 27.- Continued.



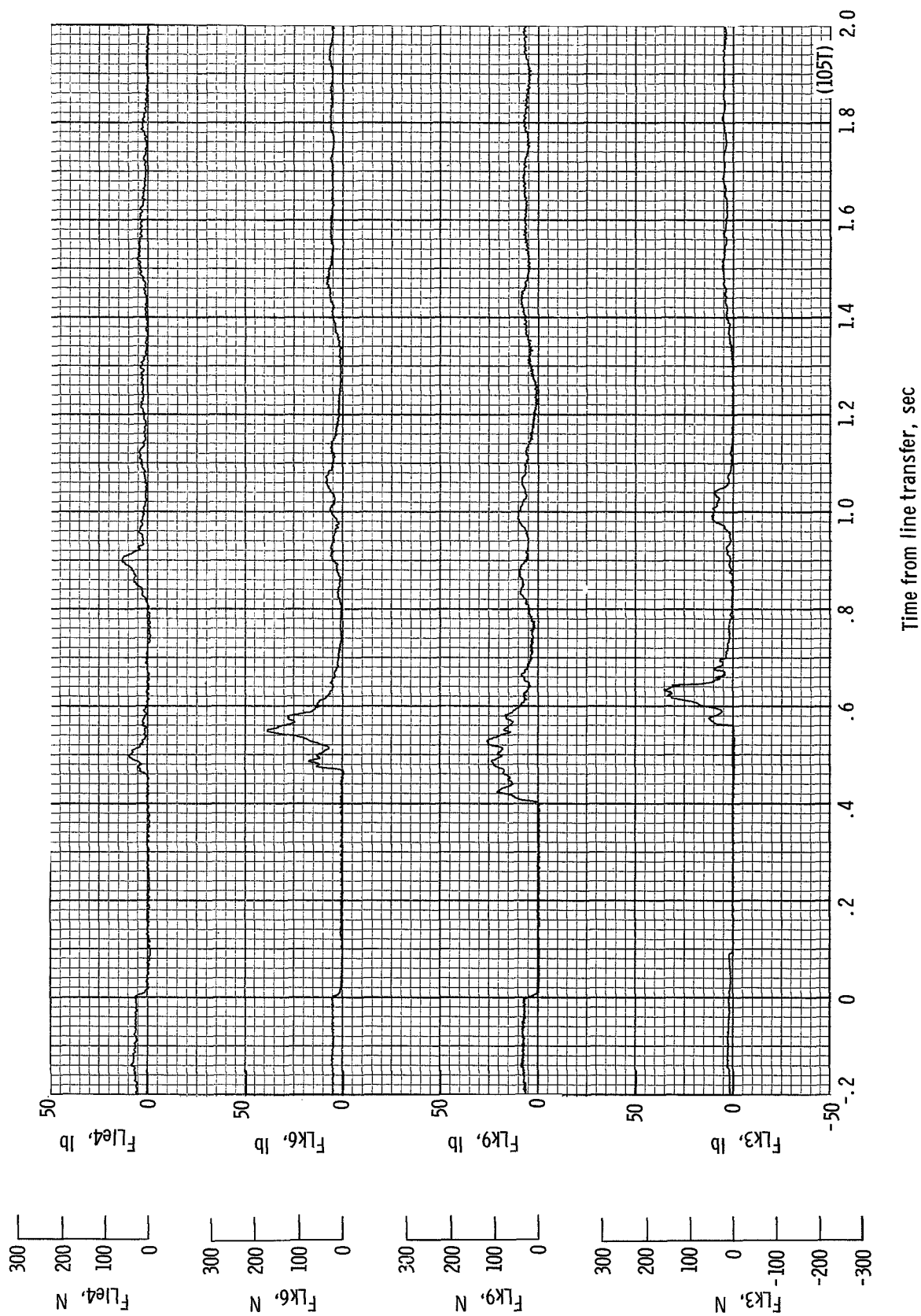
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 33.55 seconds after launch.

Figure 27.- Continued.



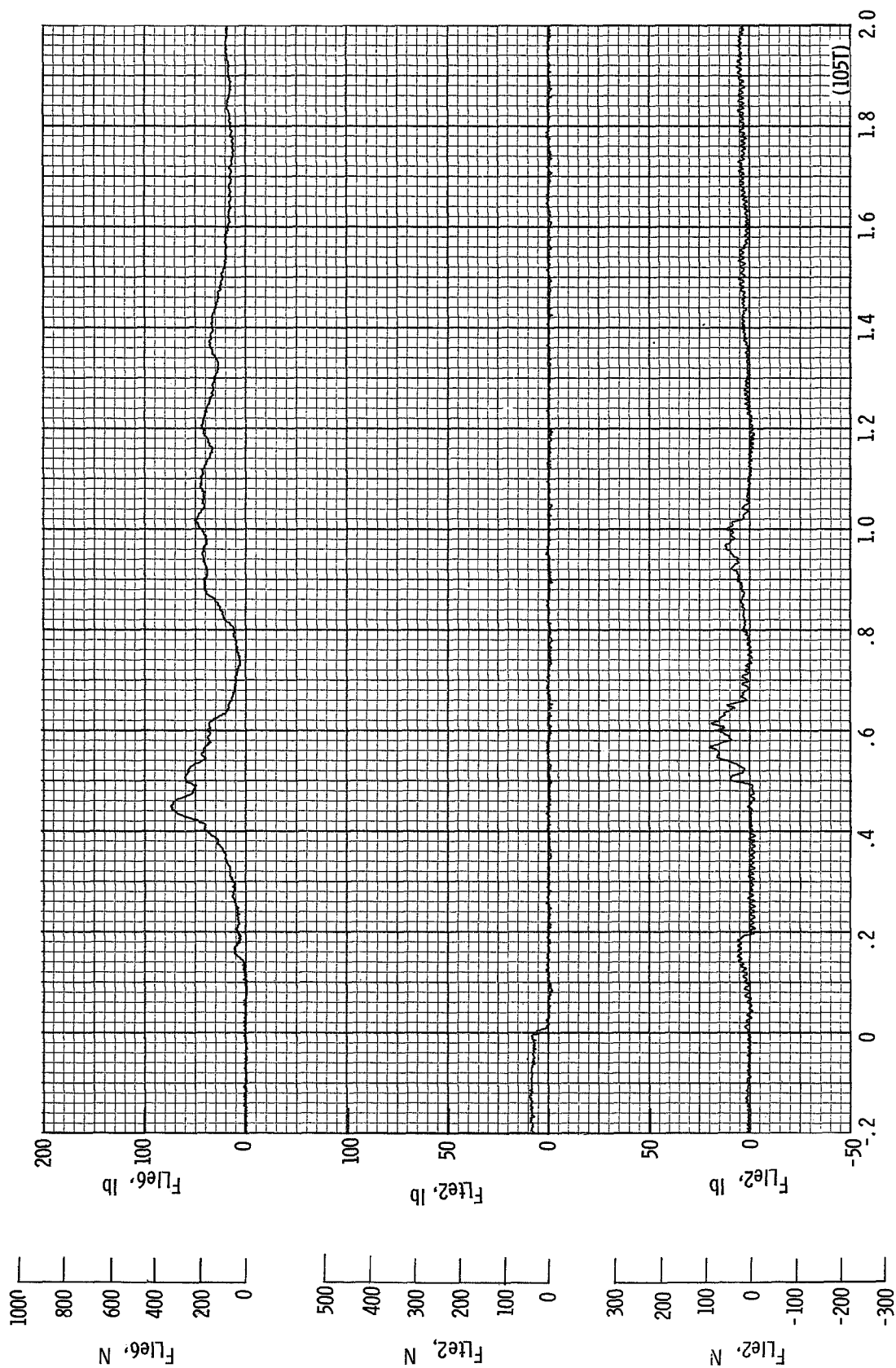
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 33.55 seconds after launch.

Figure 27.- Continued.



(u) Individual suspension-line loads F_{Lk3} , F_{Lk9} , F_{Lk6} , and F_{Lle4} plotted against time from line transfer. Time = 0 second corresponds to 36.28 seconds after launch.

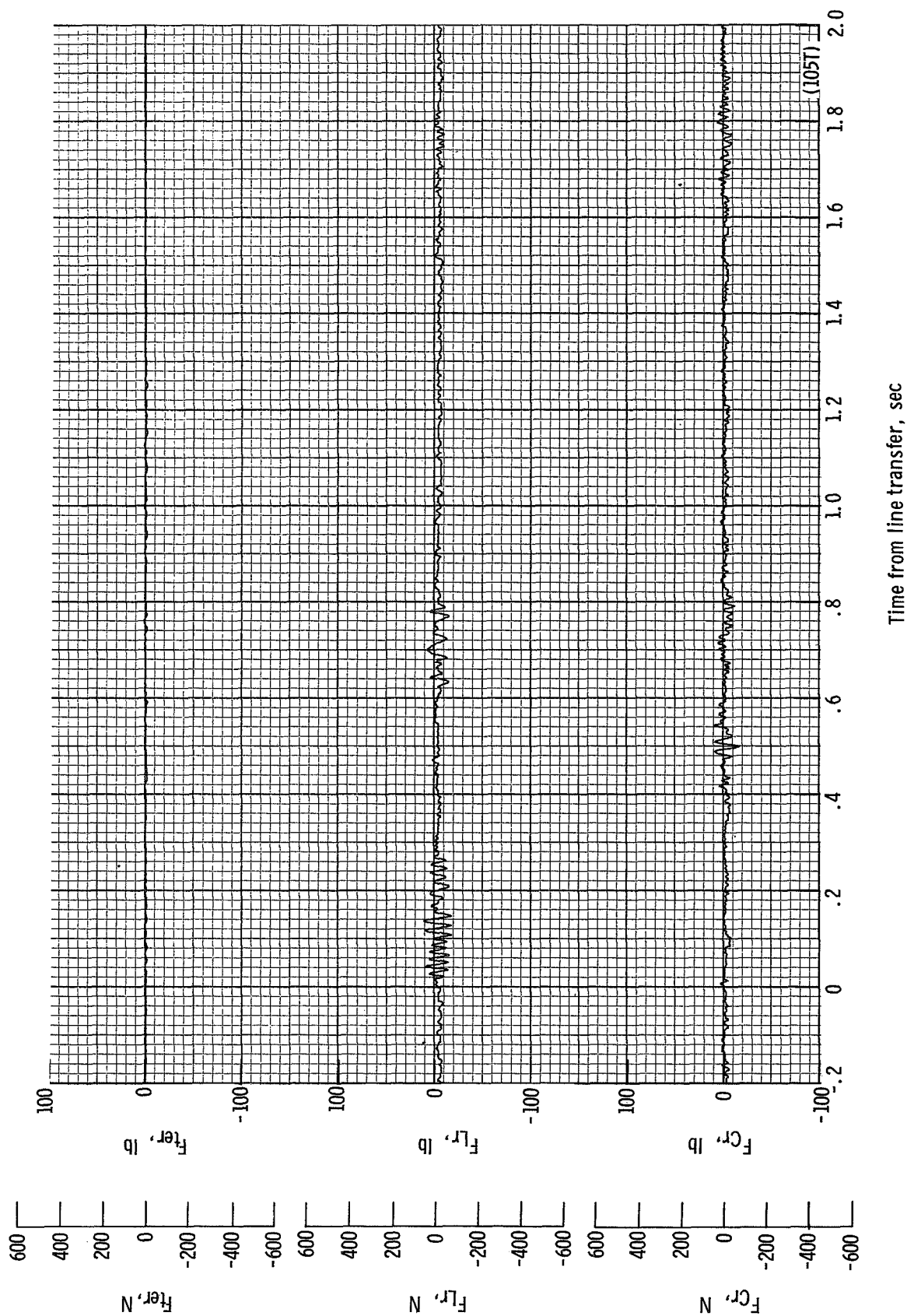
Figure 27.- Continued.



Time from line transfer, sec

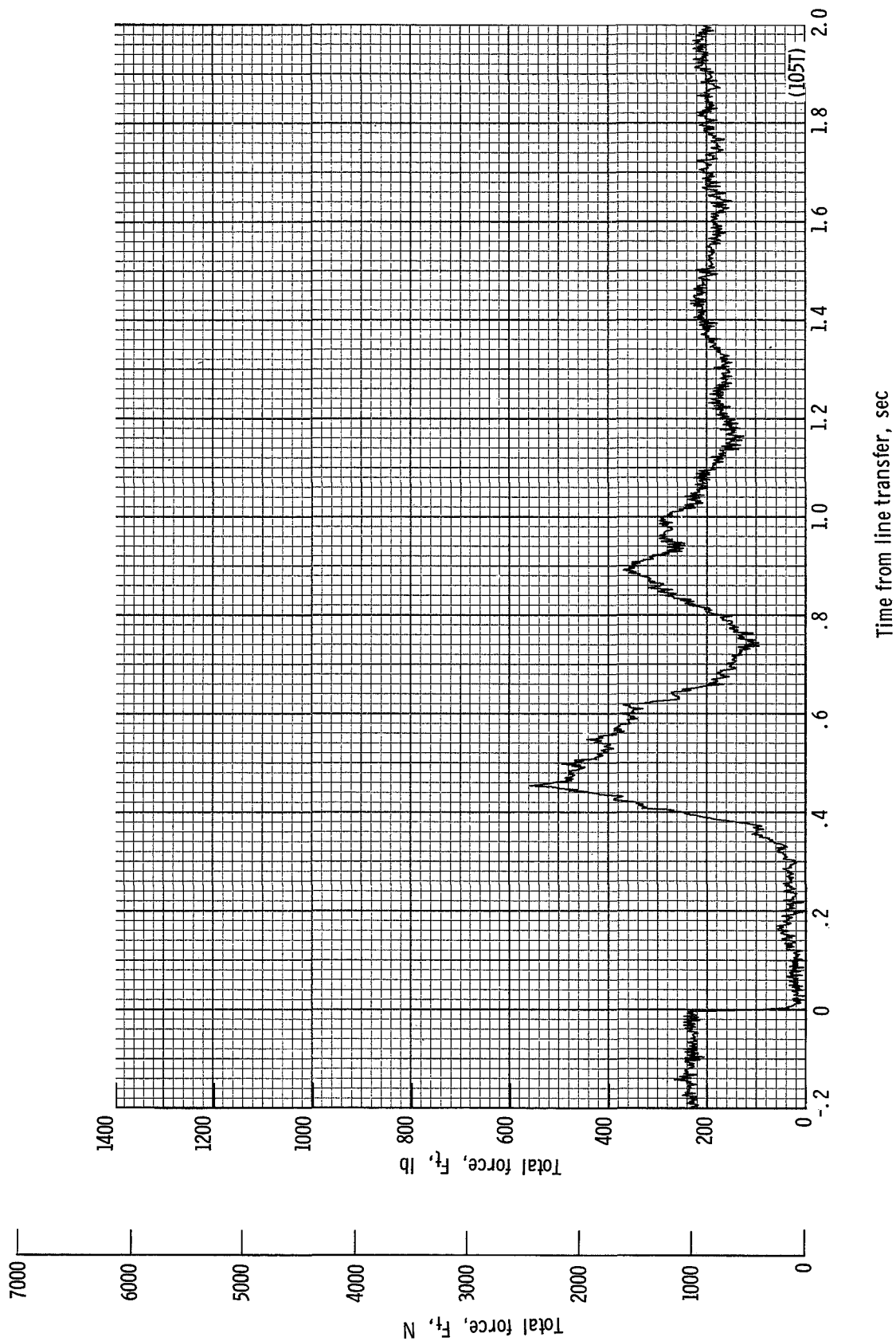
(v) Individual suspension-line loads F_{Lie2} , F_{Lie2} , and F_{Lie6} plotted against time from line transfer. Time = 0 second corresponds to 36.28 seconds after launch.

Figure 27.- Continued.



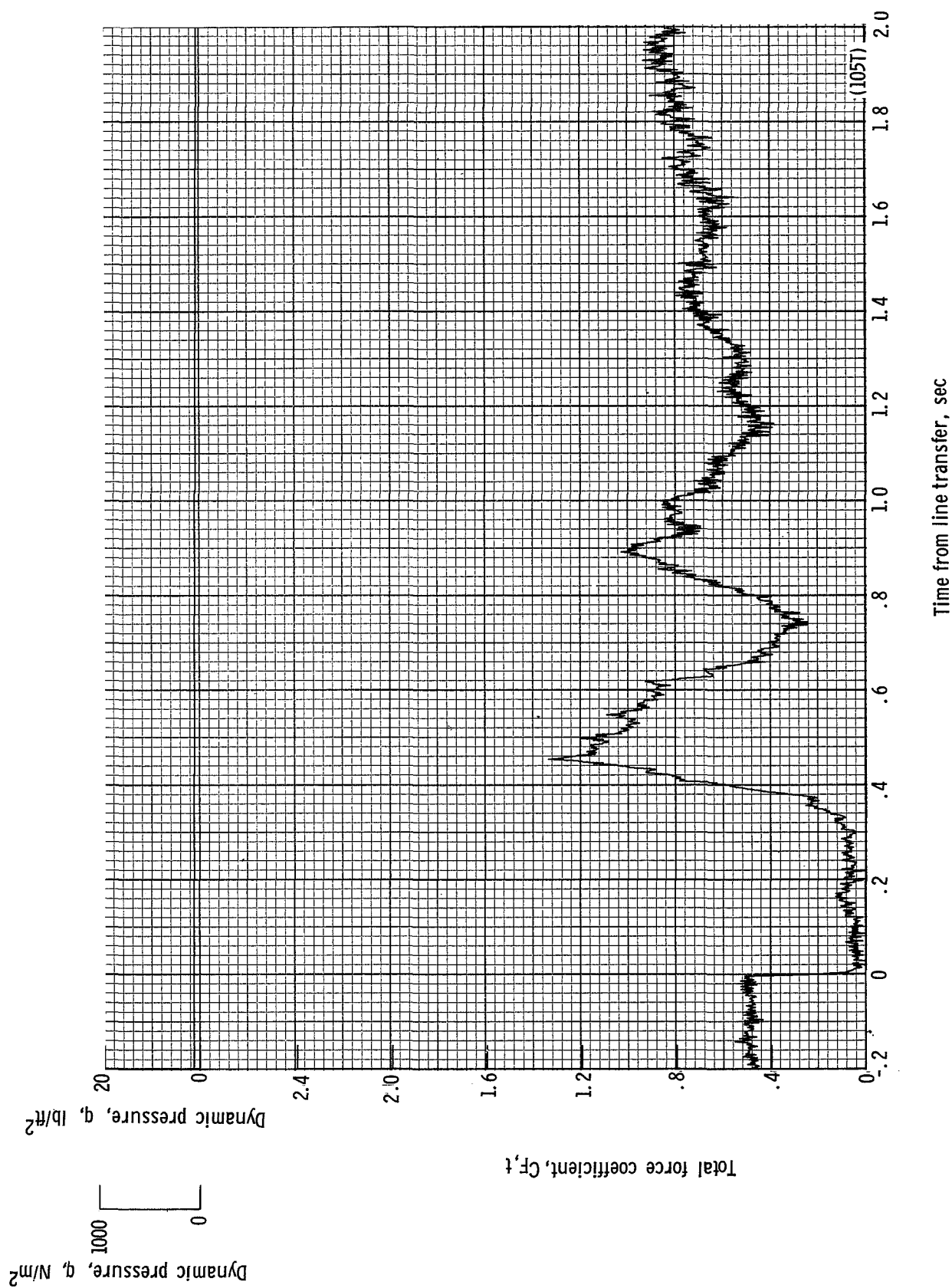
(w) Individual reefing-line loads F_{Cr} , F_{Lr} , and F_{Fer} plotted against time from line transfer. Time = 0 second corresponds to 36.28 seconds after launch.

Figure 27.- Continued.



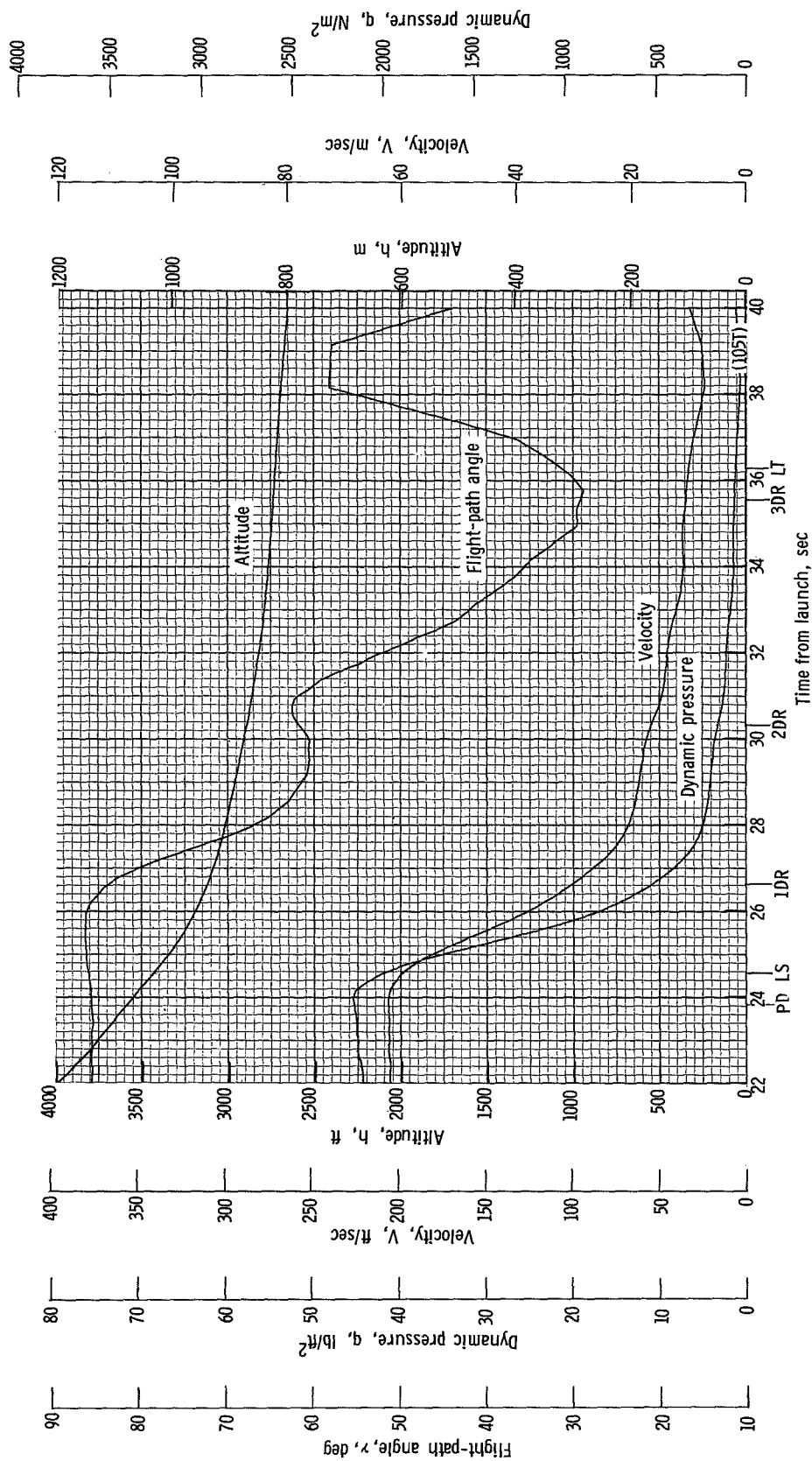
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 36.28 seconds after launch.

Figure 27.- Continued.



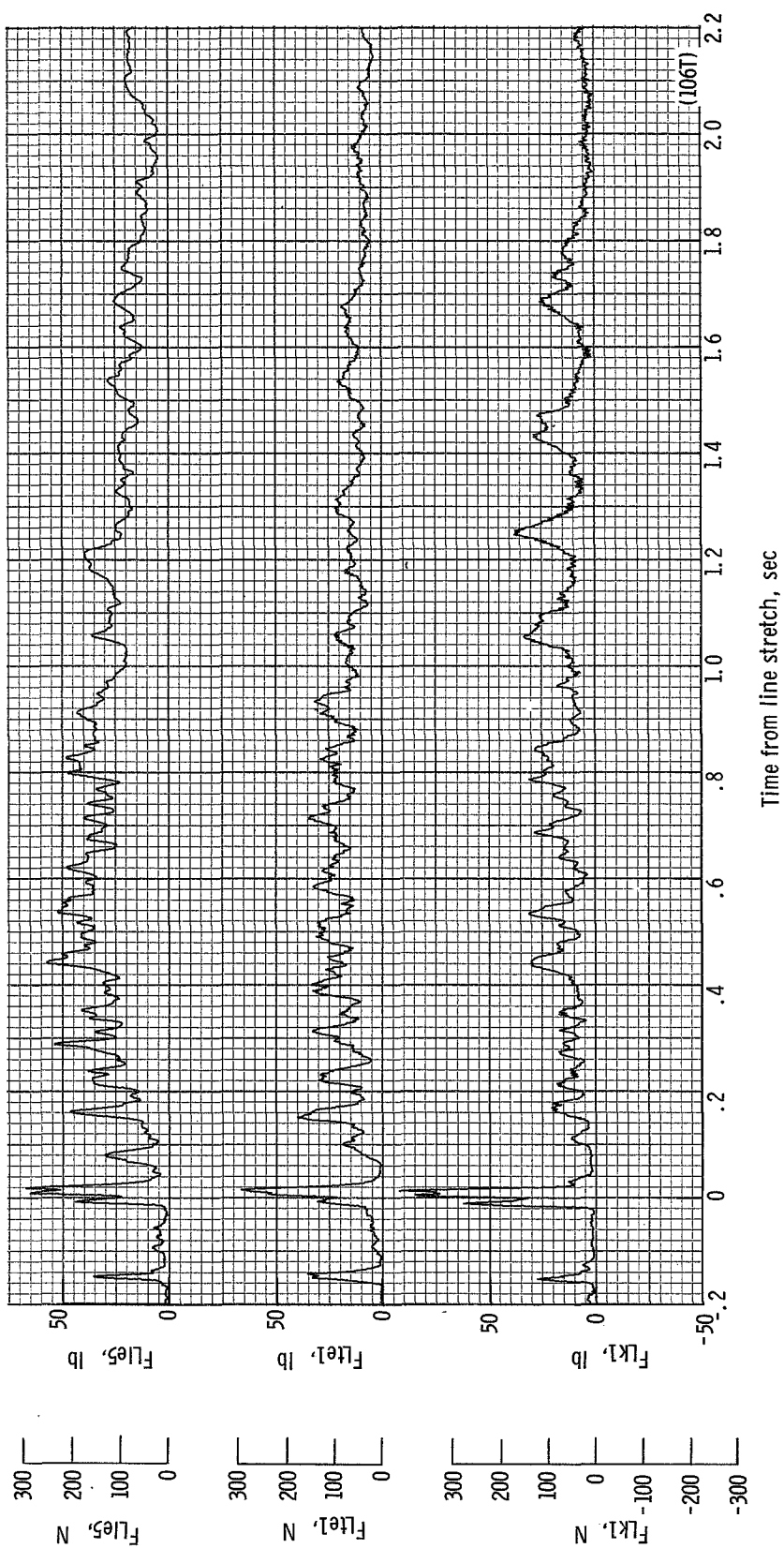
(y) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 36.28 seconds after launch.

Figure 27.- Continued.



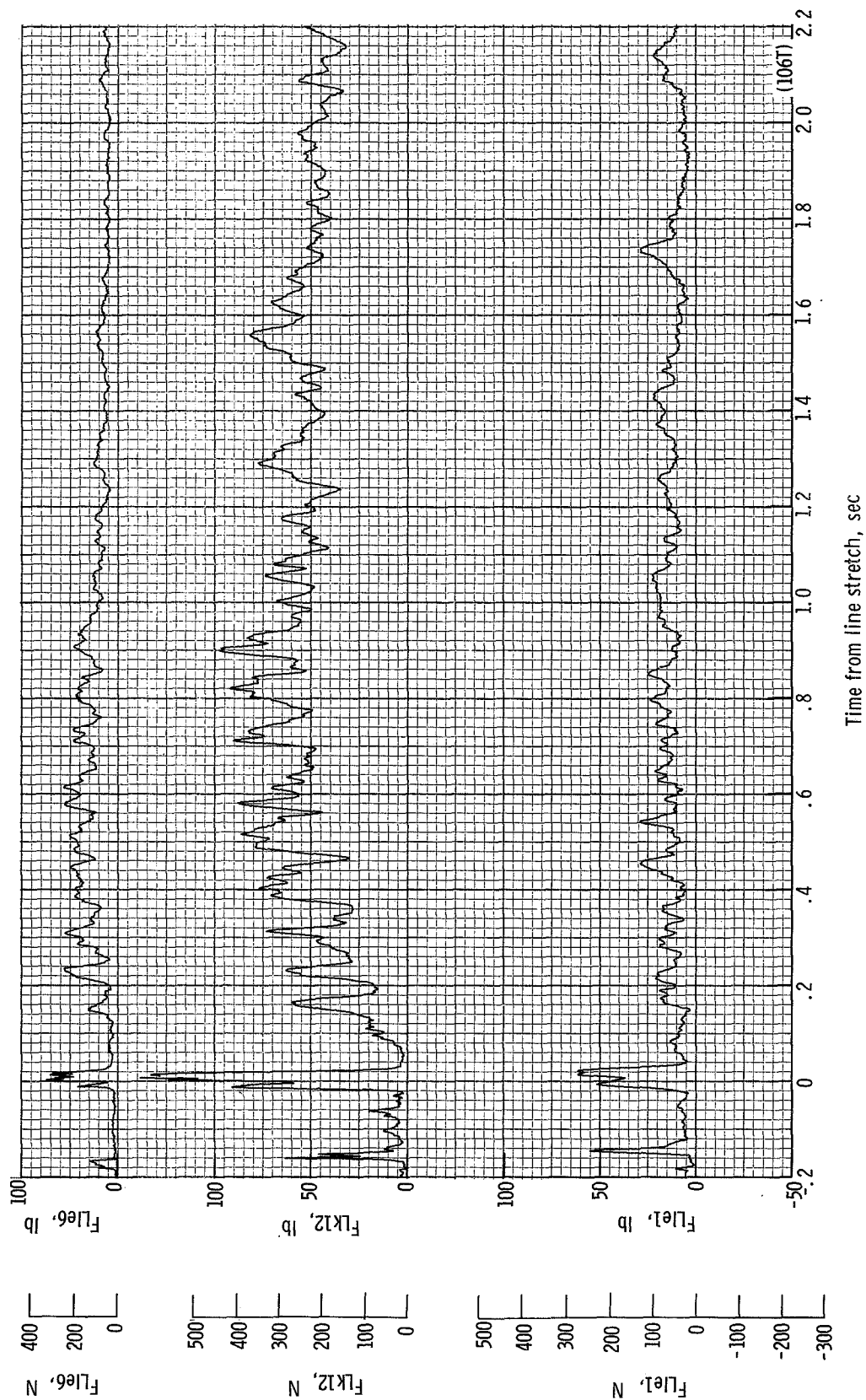
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 27.- Concluded.



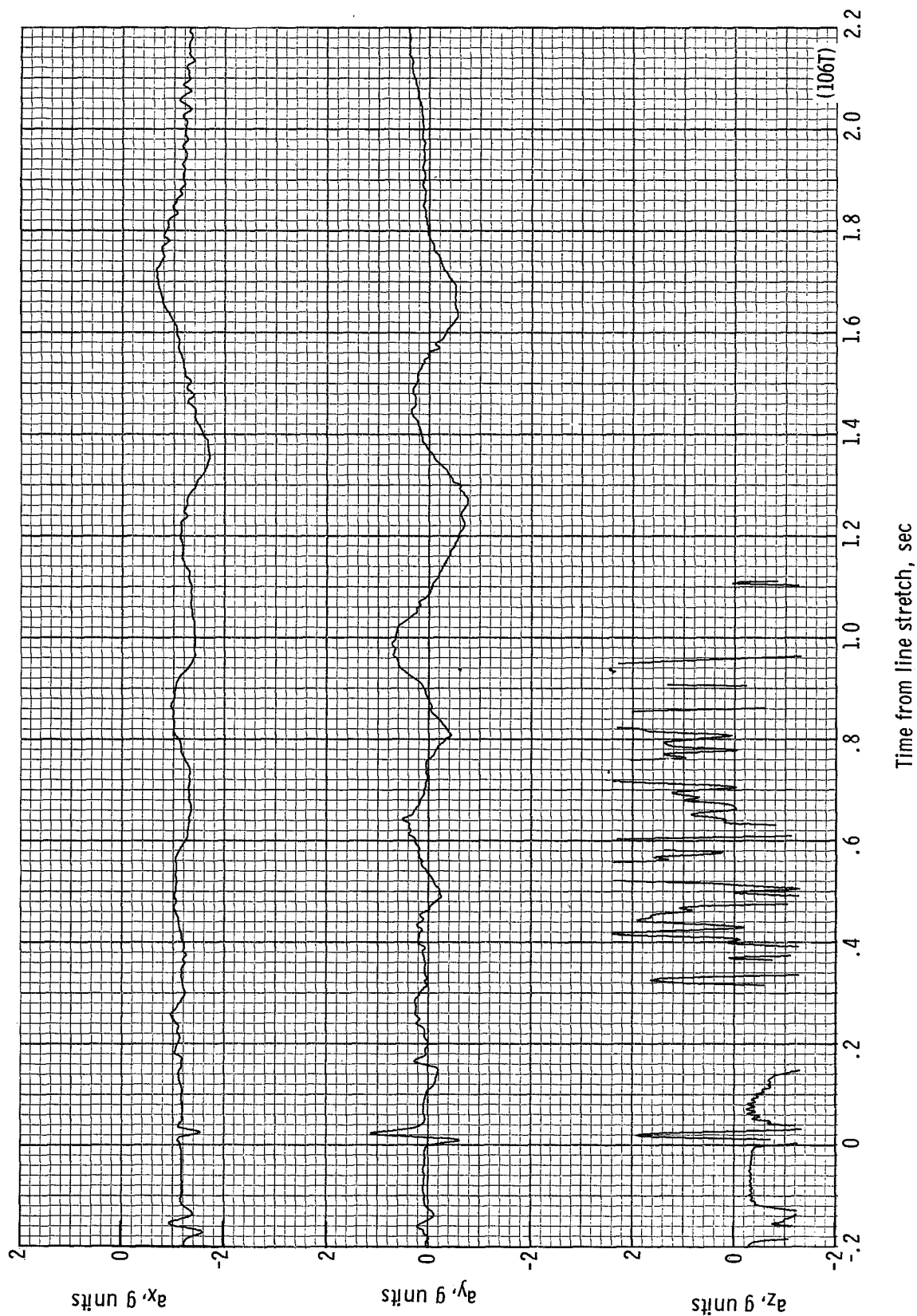
(a) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lle5} plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 28.- Time history of twin-keel parawing deployment data for test 106T. $W_D = 2234.8$ N (502.4 lb); $W_P = 2079.5$ N (467.5 lb); $q_{PD} = 3552.7$ N/m² (74.2 lb/ft²); $h_{PD} = 5712$ m (18 740 ft); $t_r/t_k = 0.153$; reefing version 1.



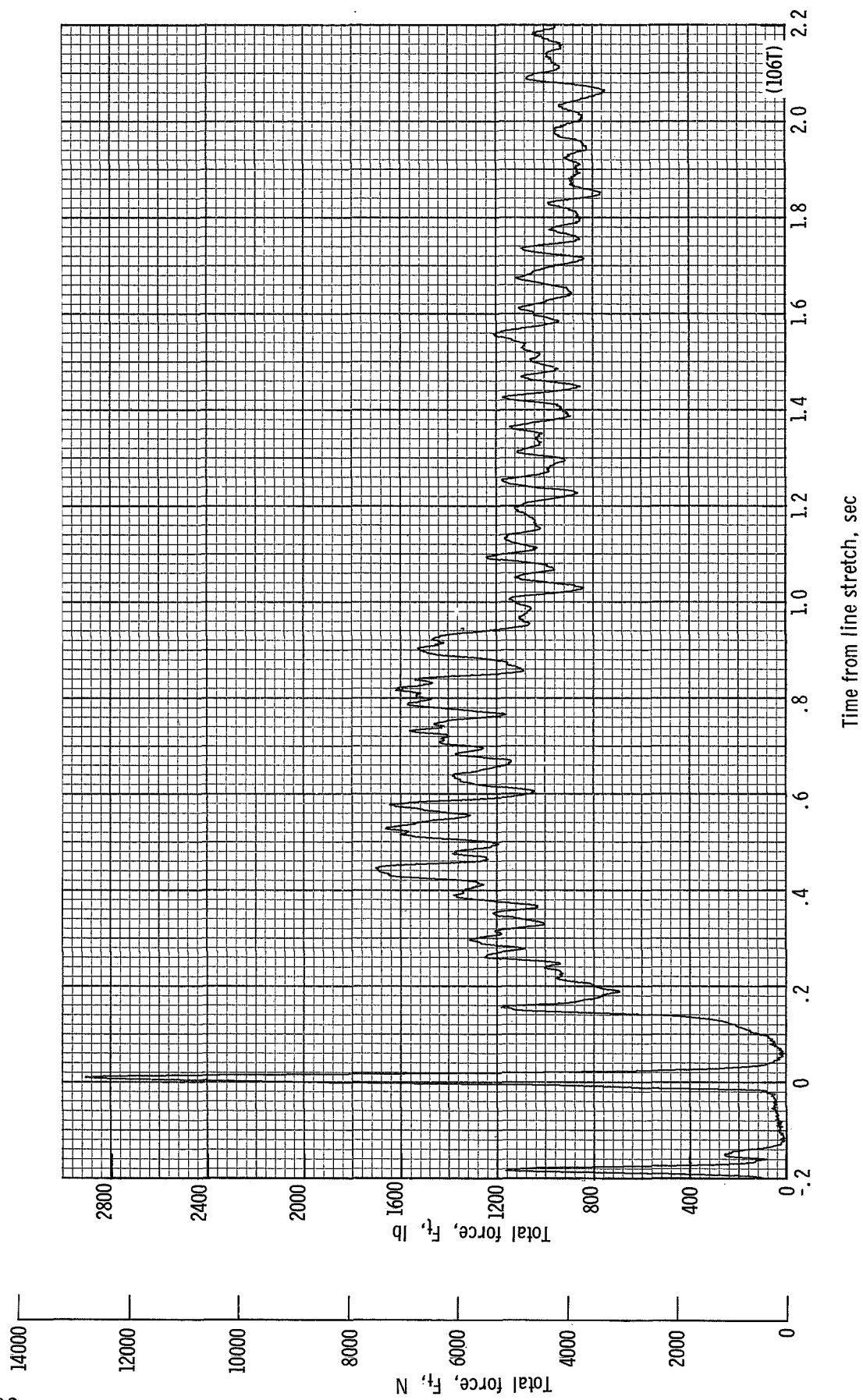
(b) Individual suspension-line loads F_{L1e1} , F_{LK12} , and F_{L1e6} plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 28.- Continued.



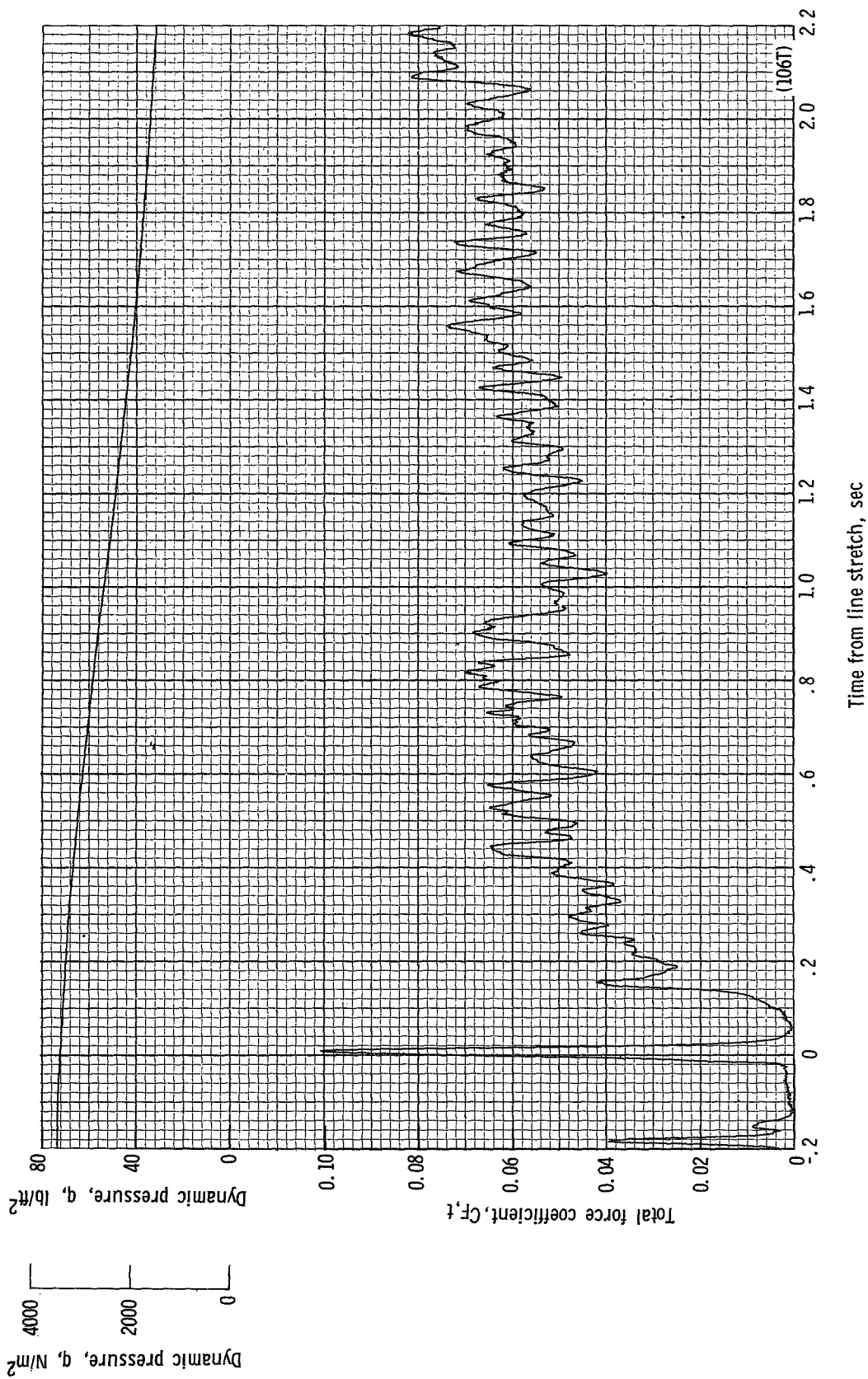
(c) Accelerations a_z , a_y , and a_x plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 28.- Continued.



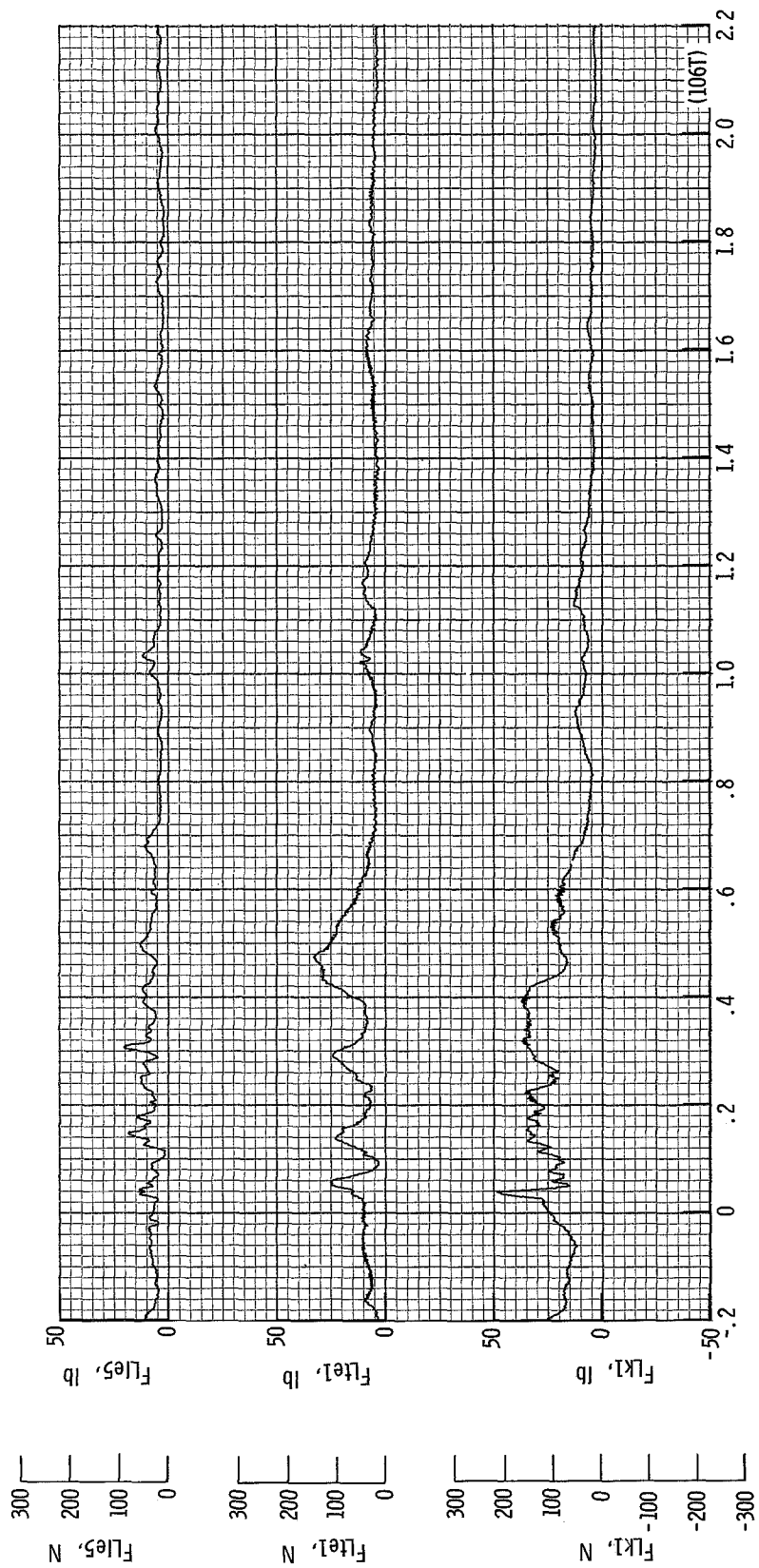
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

Figure 28.- Continued.



(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 29.96 seconds after launch.

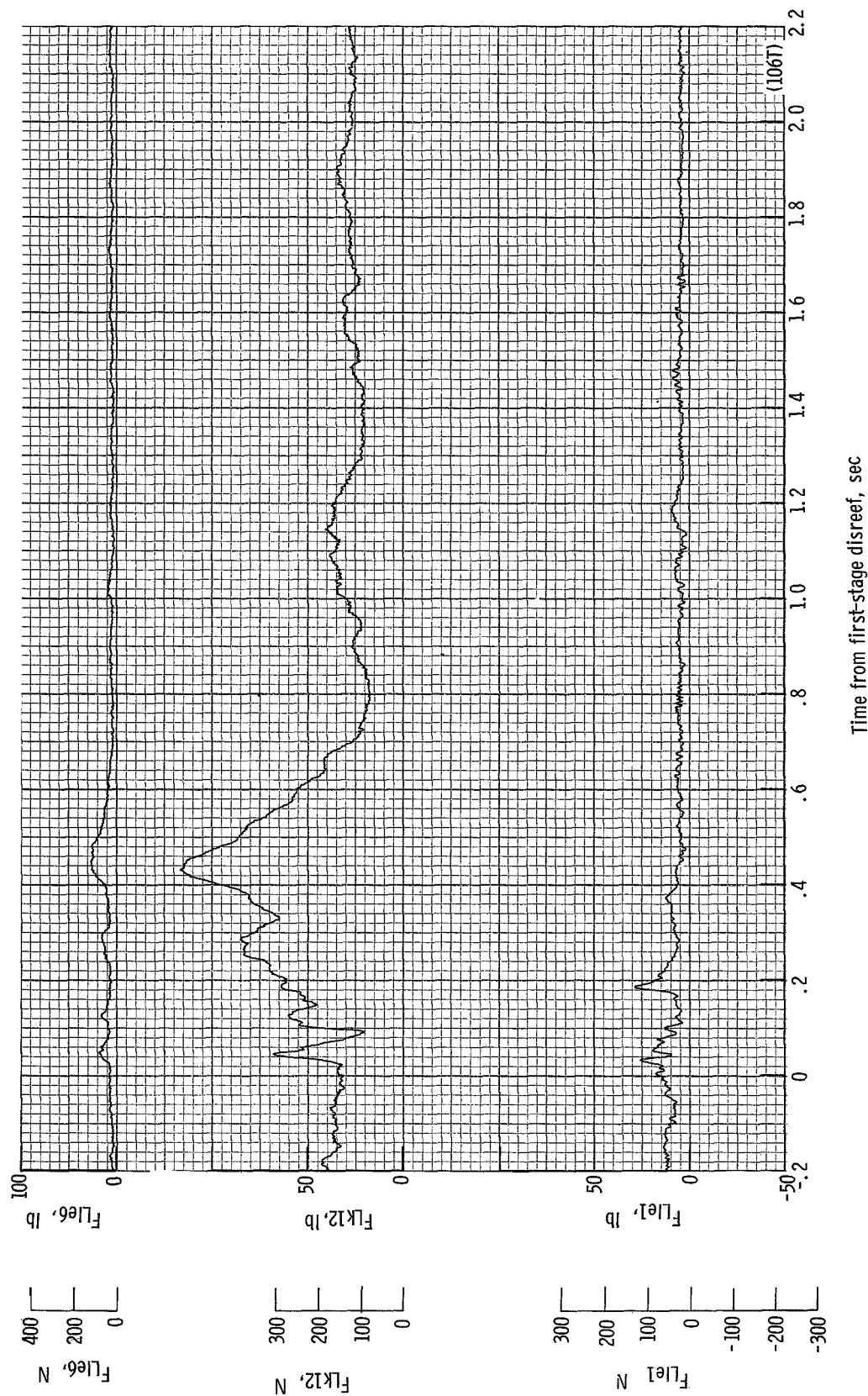
Figure 28.- Continued.



Time from first-stage disreef, sec

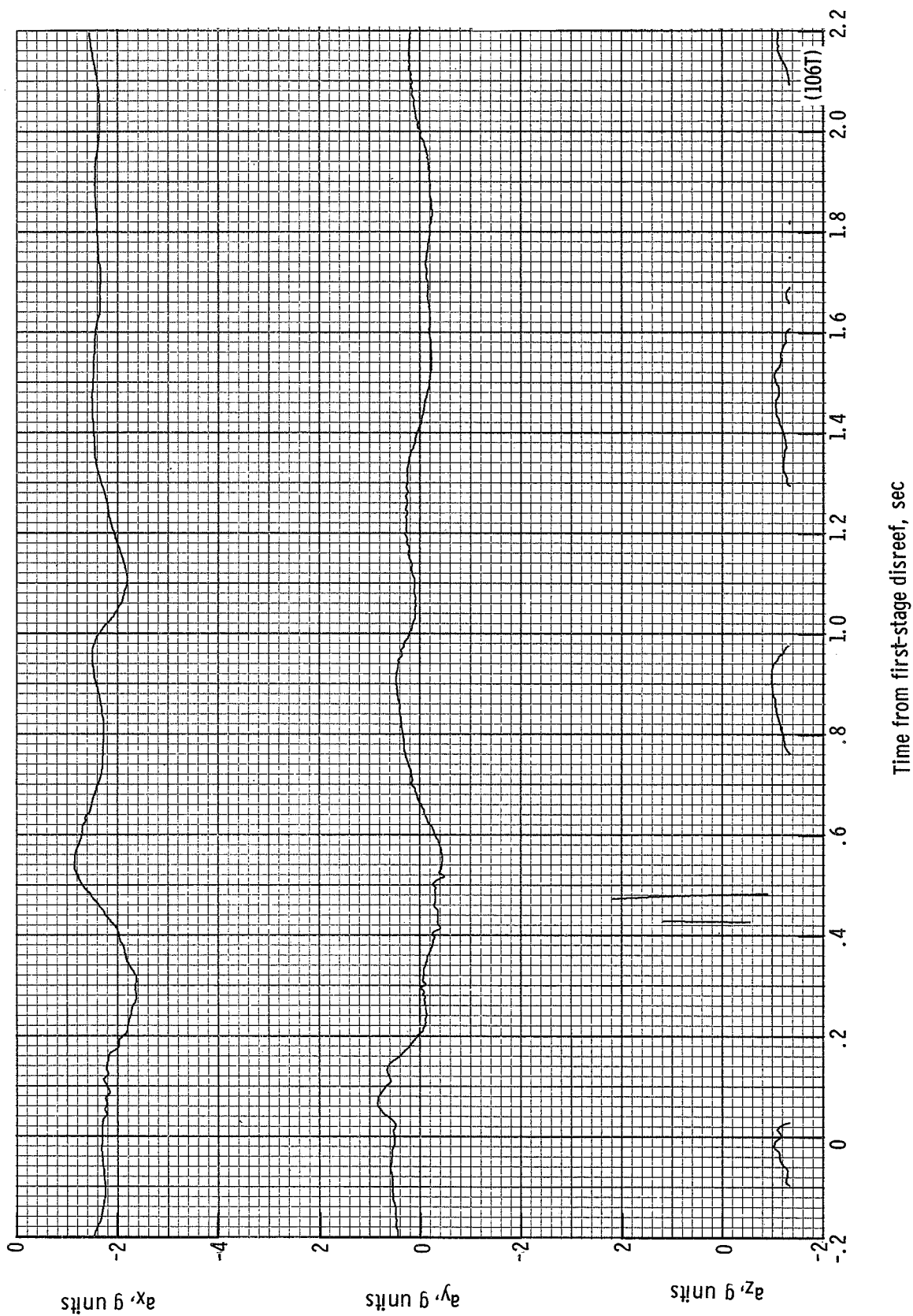
(f) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lle5} plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 28.- Continued.



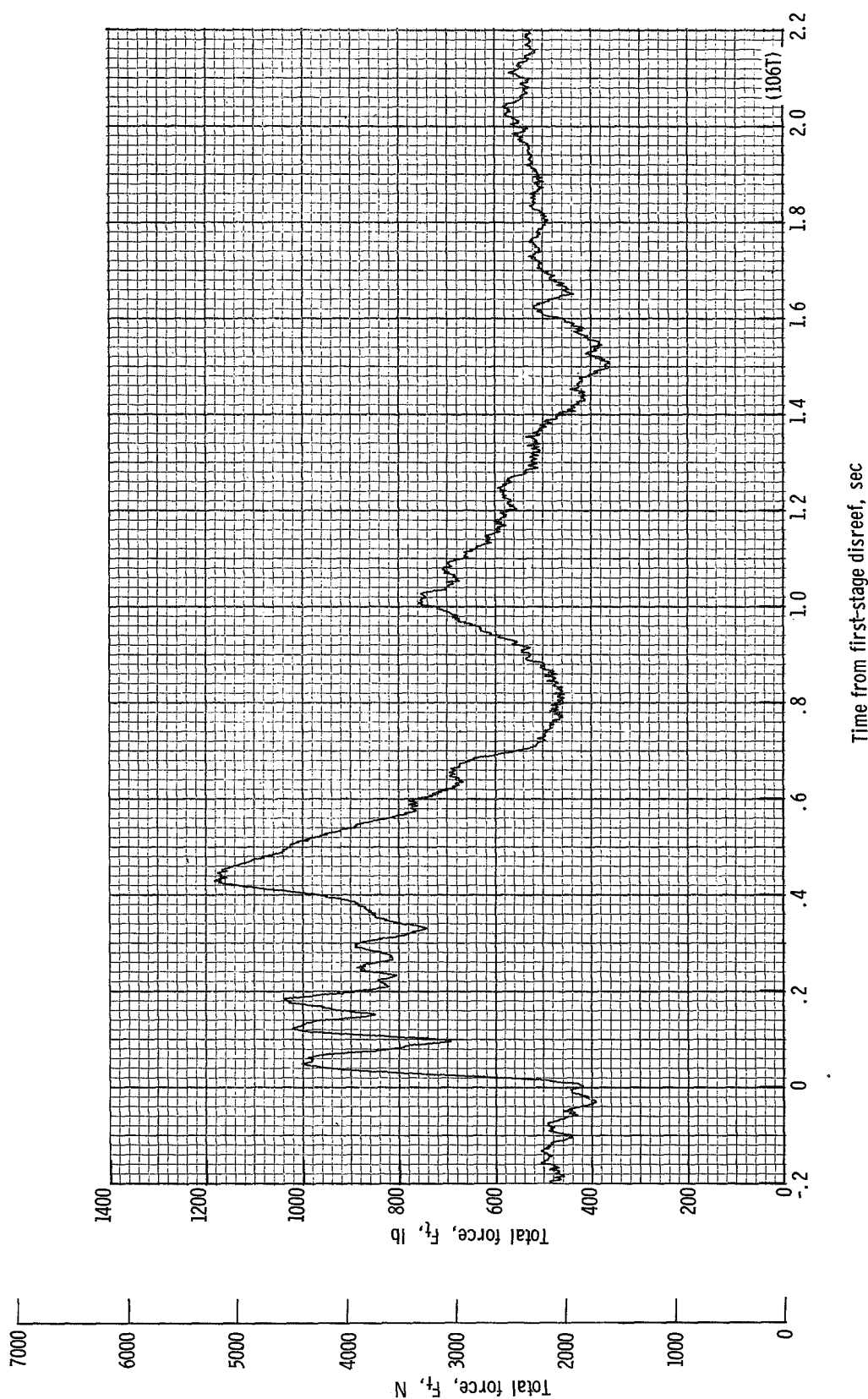
(g) Individual suspension-line loads F_{L1e1} , F_{Lk12} , and F_{L1e6} plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 28.- Continued.



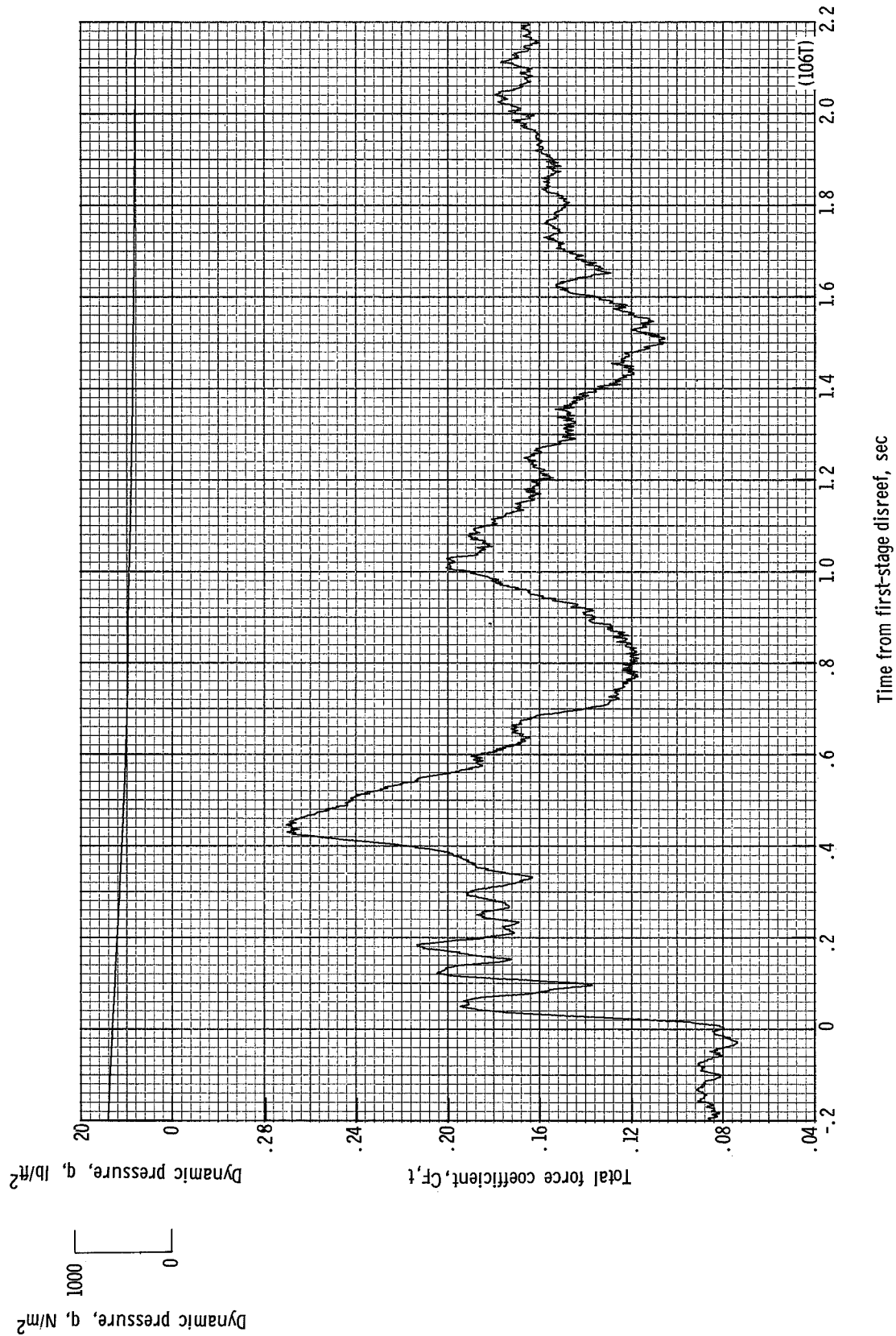
(h) Accelerations a_z , a_y , and a_x plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 28. - Continued.



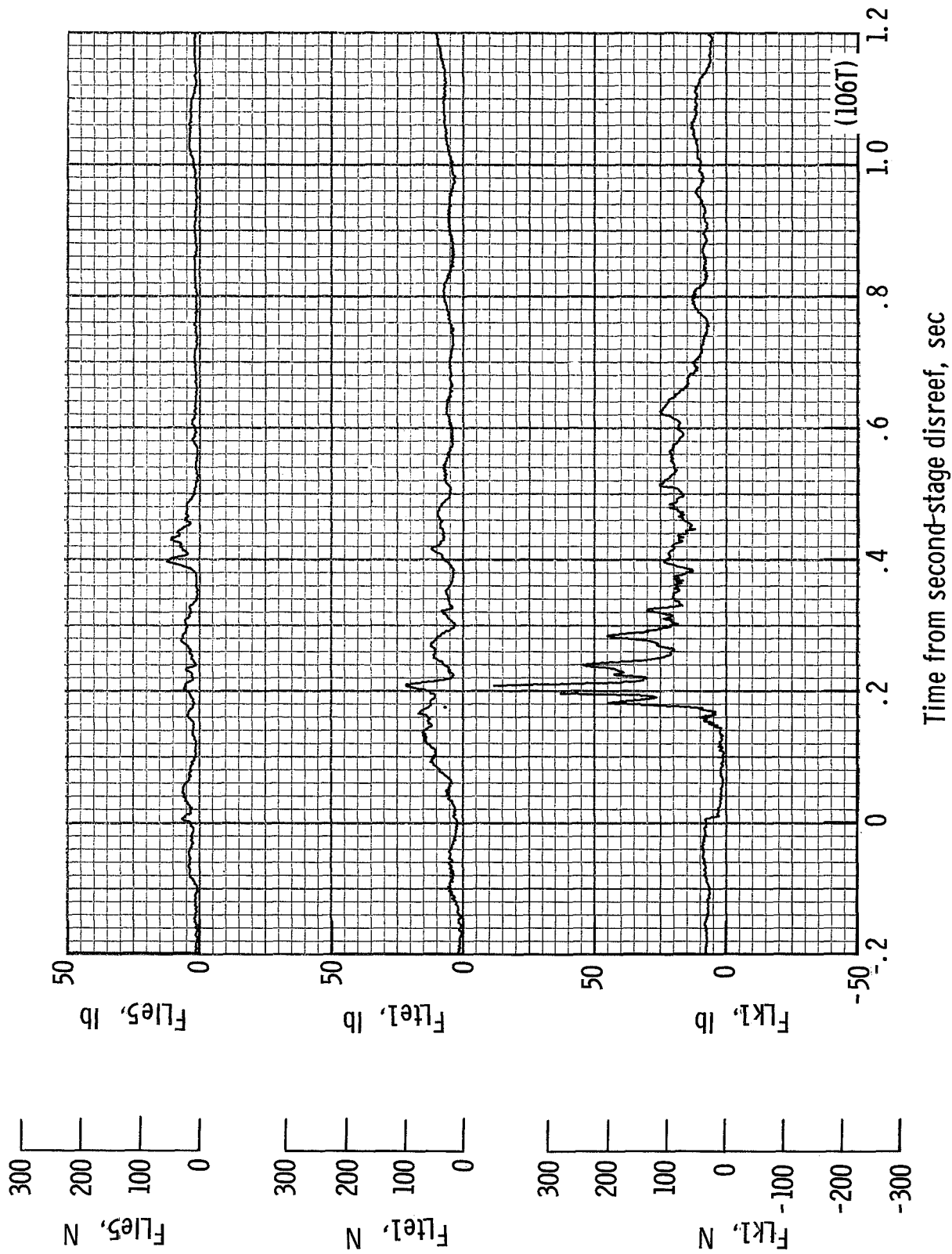
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 28.- Continued.



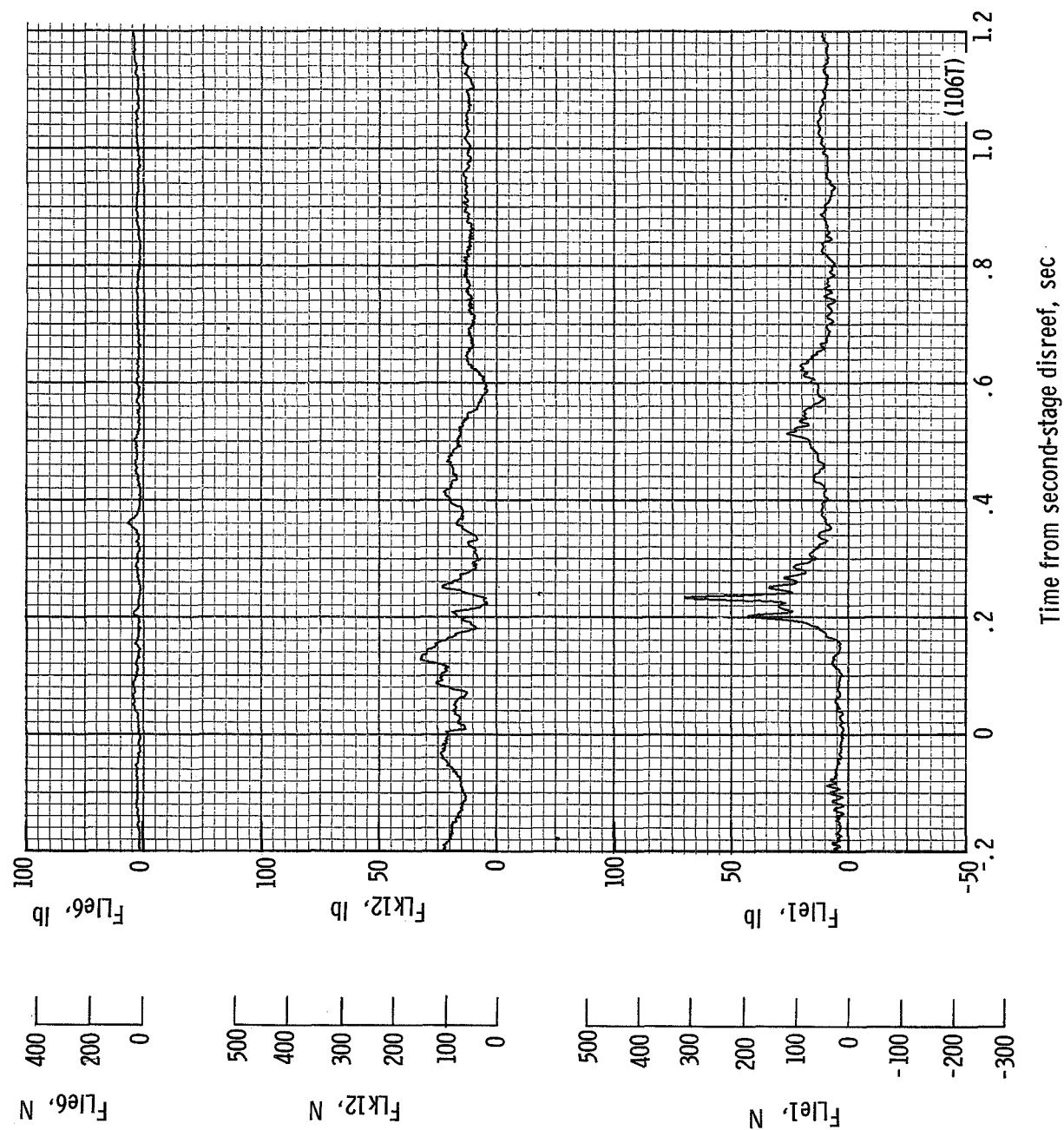
(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 35.33 seconds after launch.

Figure 28.- Continued.



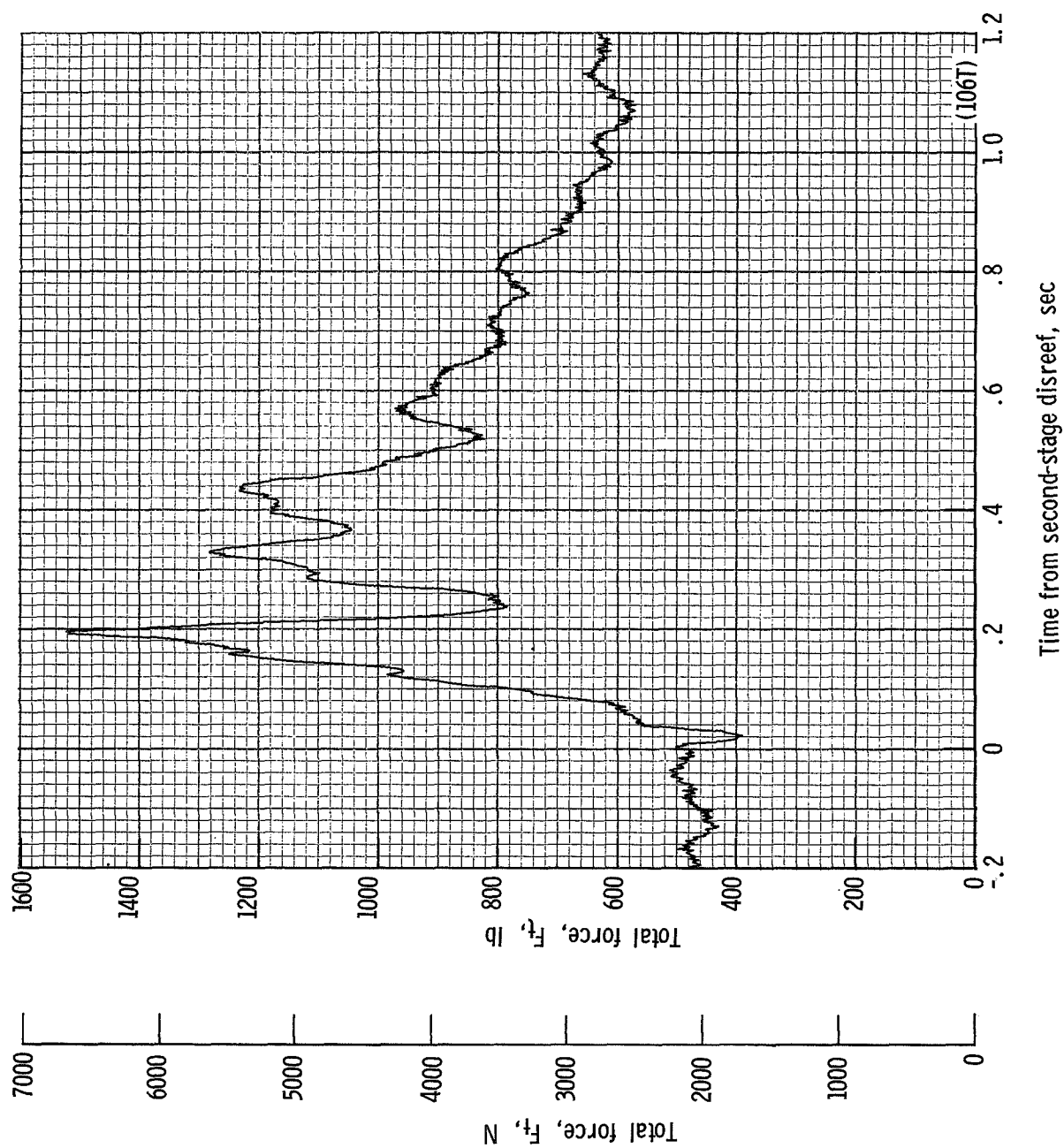
(k) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lie5} plotted against time from second-stage disreef. Time = 0 second corresponds to 39.64 seconds after launch.

Figure 28.- Continued.



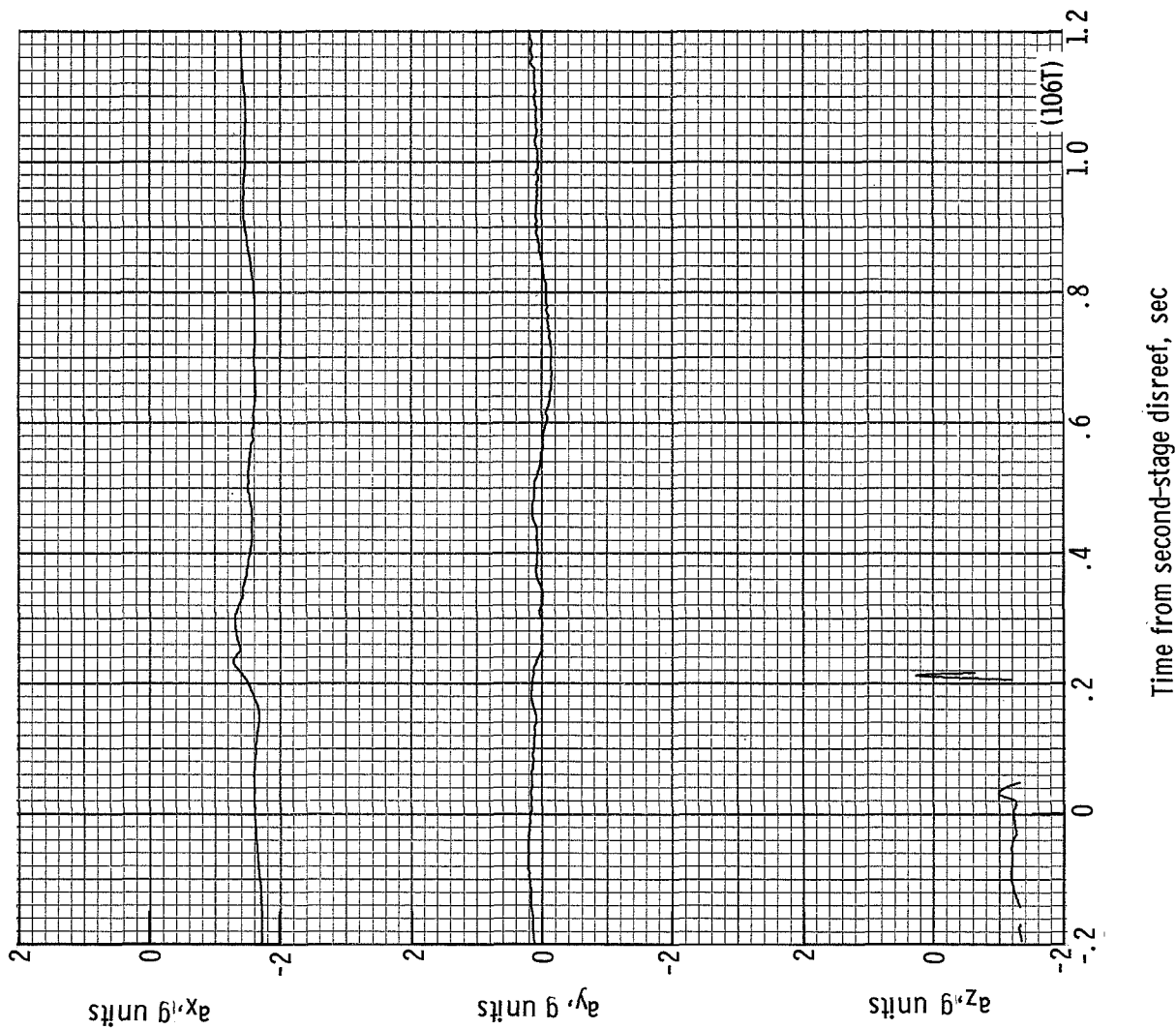
(1) Individual suspension-line loads F_{Lle1} , F_{Lk12} , and F_{Lle6} plotted against time from second-stage disreef. Time = 0 second corresponds to 39.64 seconds after launch.

Figure 28.- Continued.

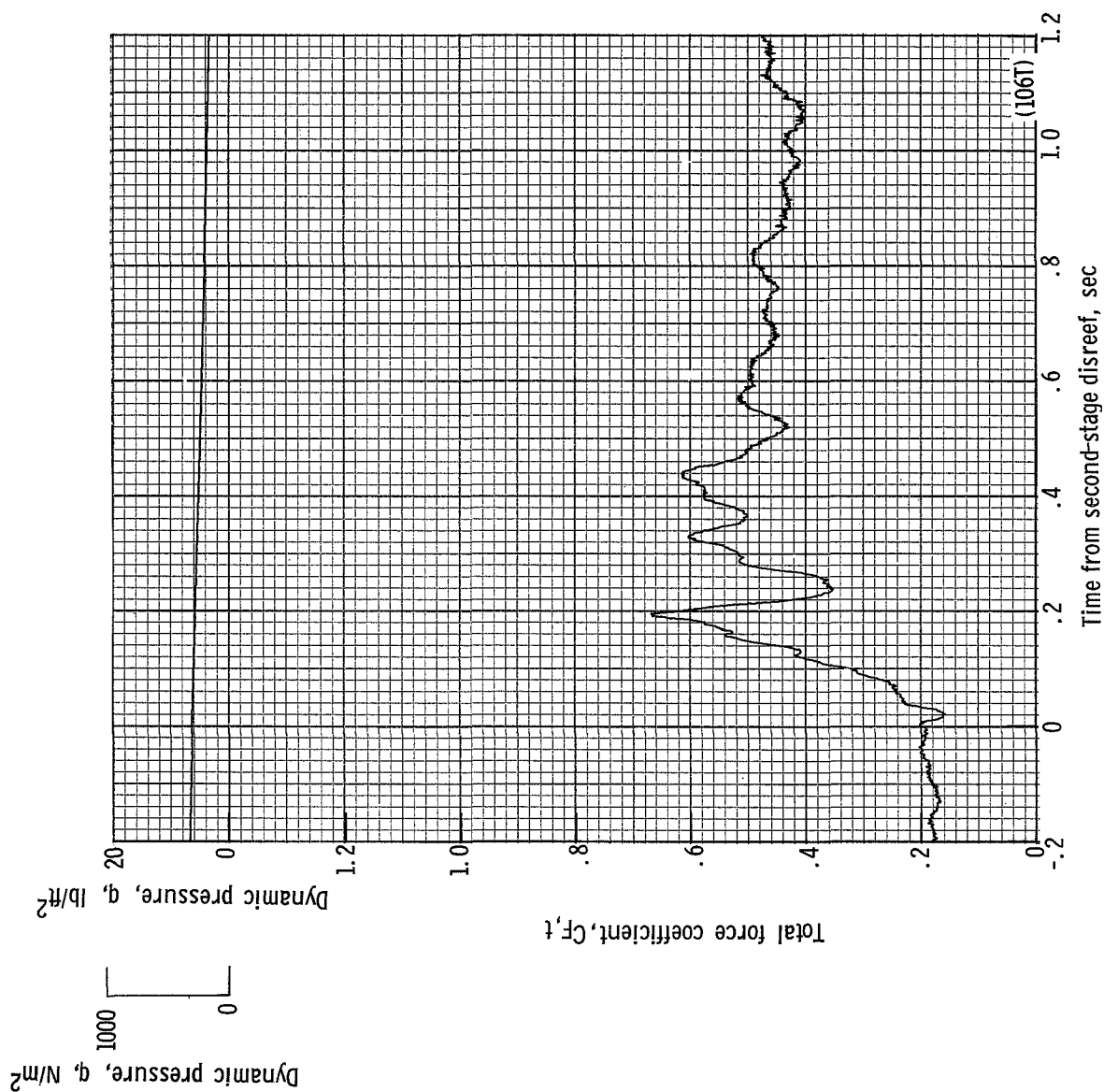


(m) Accelerations a_z , a_y , and a_x plotted against time from second-stage disreef. Time = 0 second corresponds to 39.64 seconds after launch.

Figure 28.- Continued.

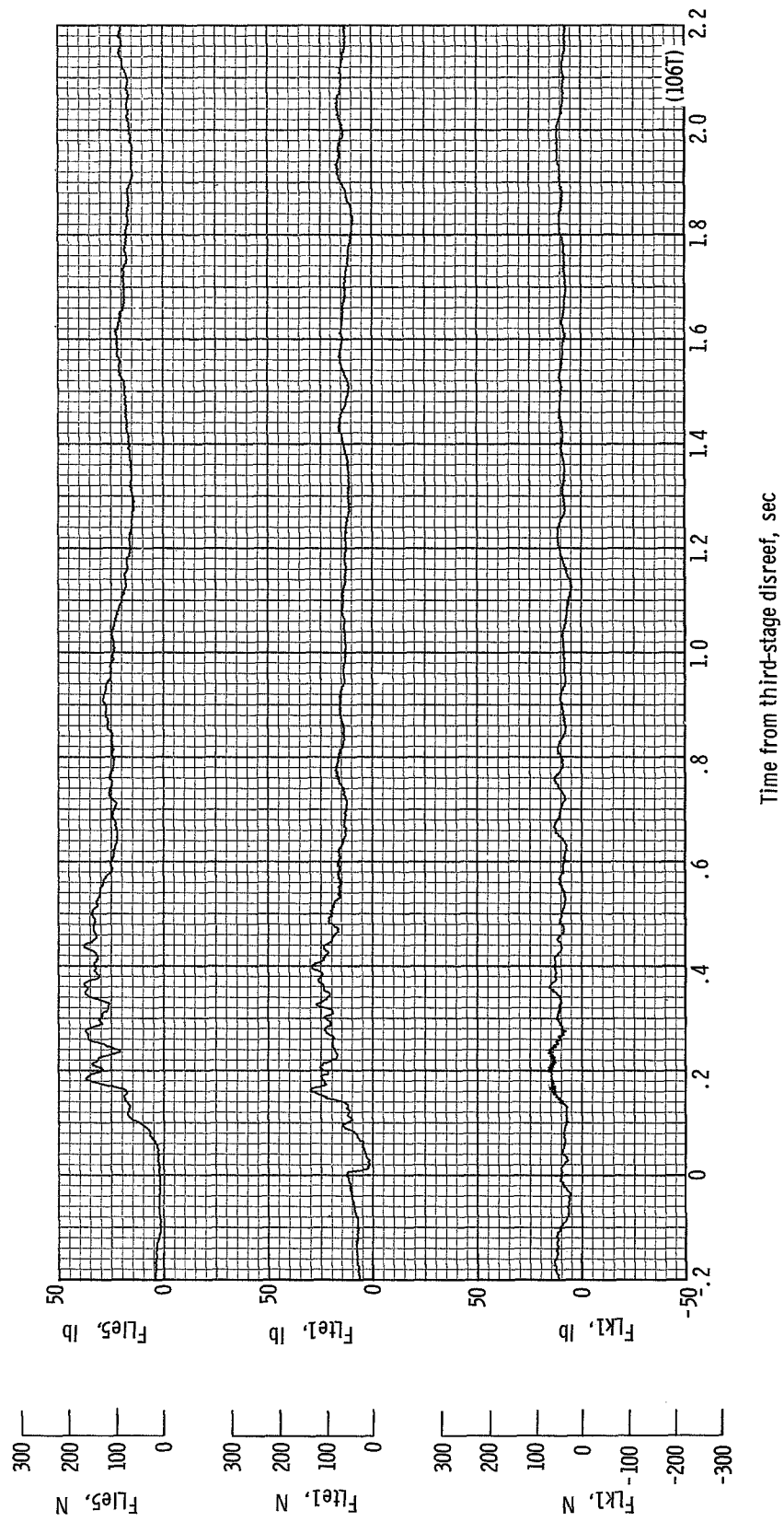


(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 39.64 seconds after launch.



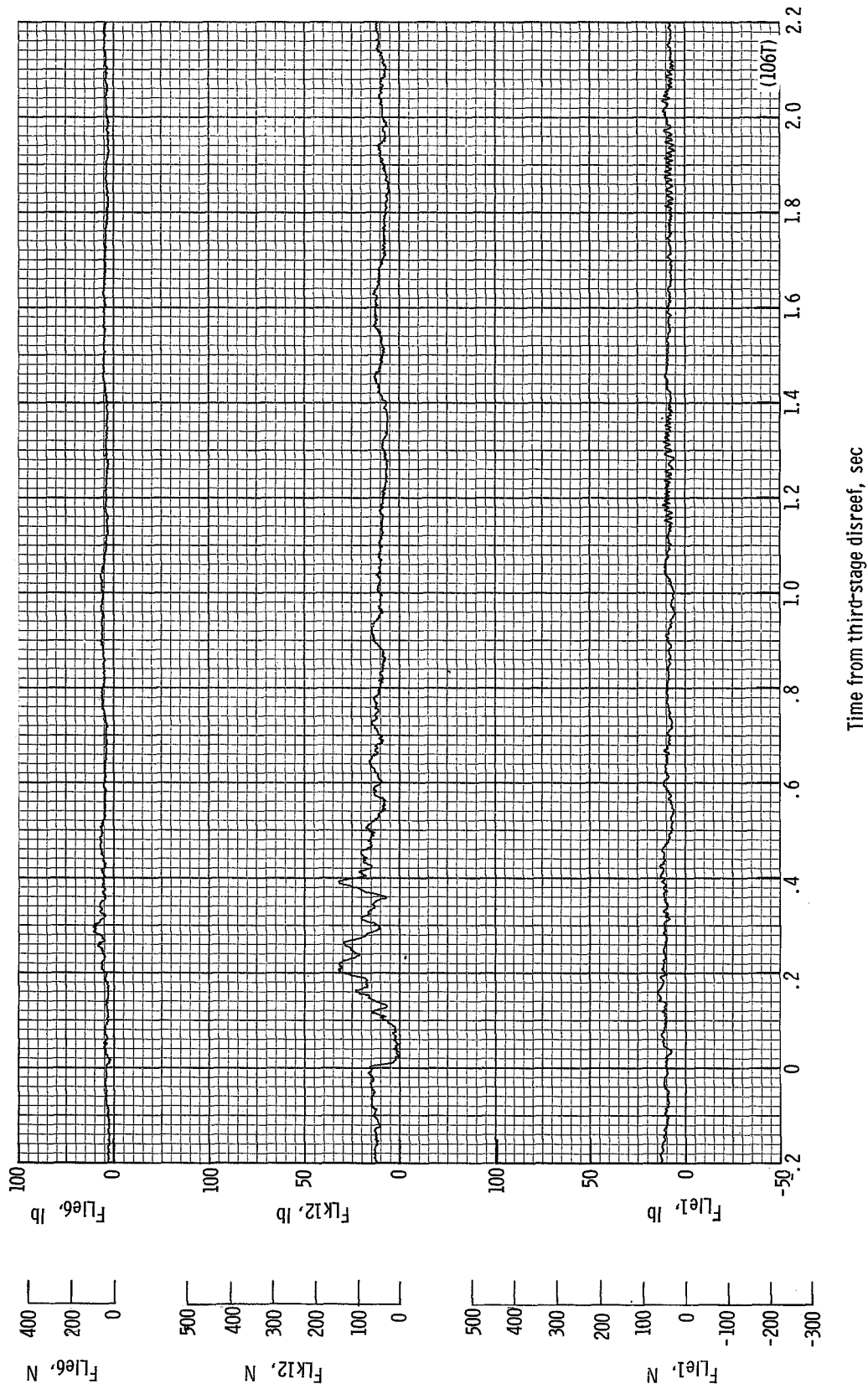
(o) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 39.64 seconds after launch.

Figure 28.- Continued.



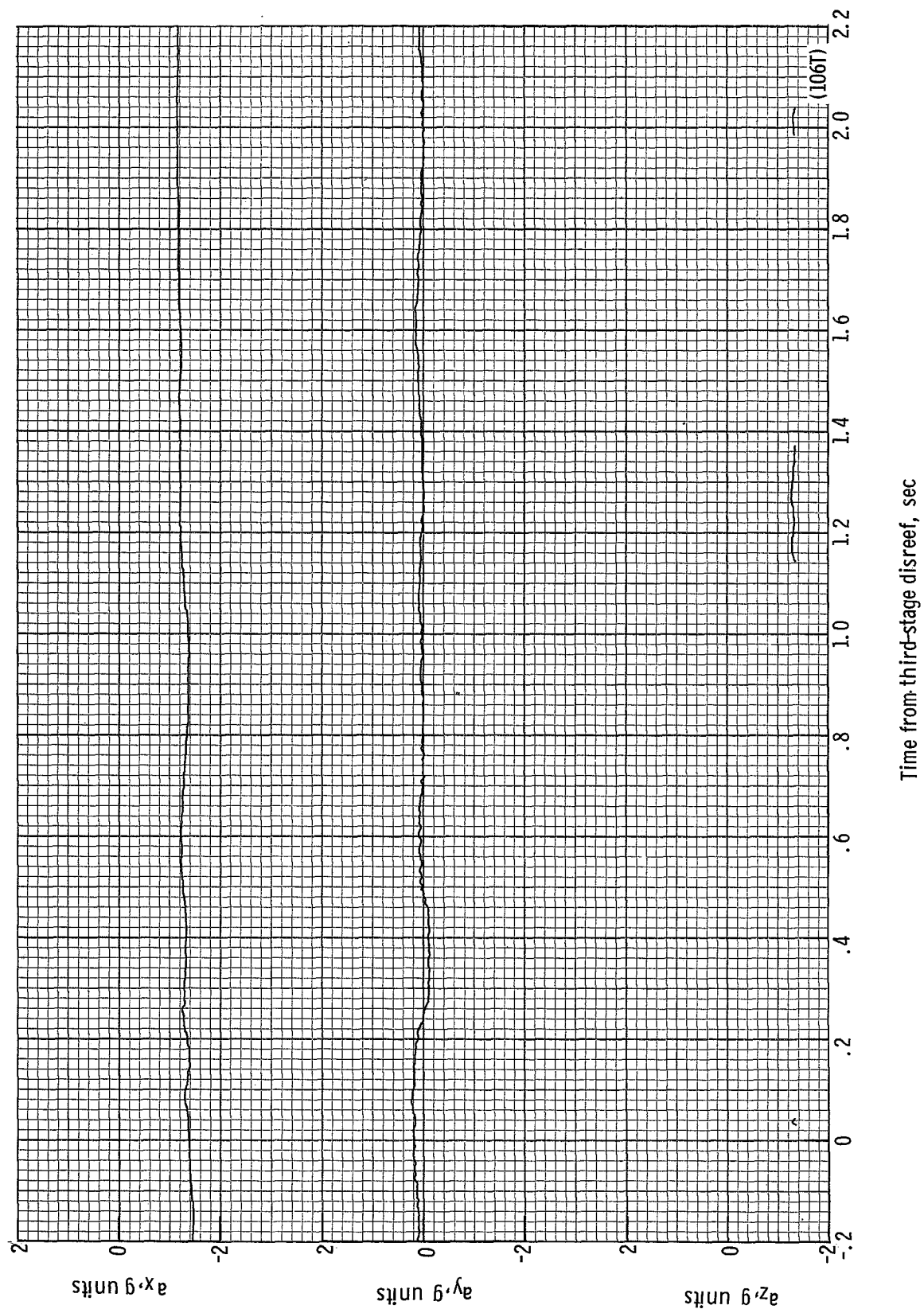
(p) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lie5} plotted against time from third-stage disreef. Time = 0 second corresponds to 40.87 seconds after launch.

Figure 28.- Continued.



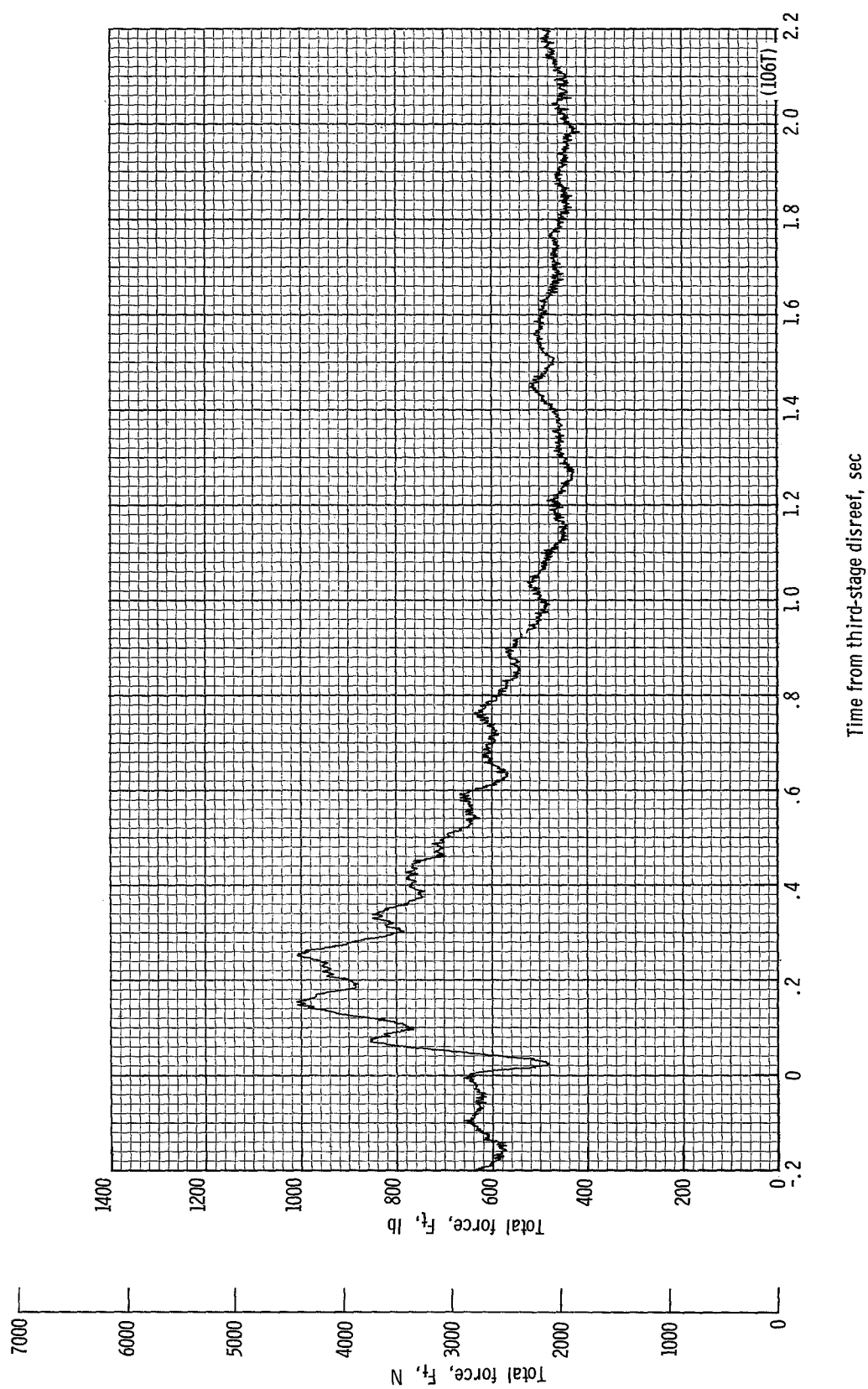
(q) Individual suspension-line loads F_{Lle1} , F_{LK12} , and F_{Lle6} plotted against time from third-stage disreef. Time = 0 second corresponds to 40.87 seconds after launch.

Figure 28.- Continued.



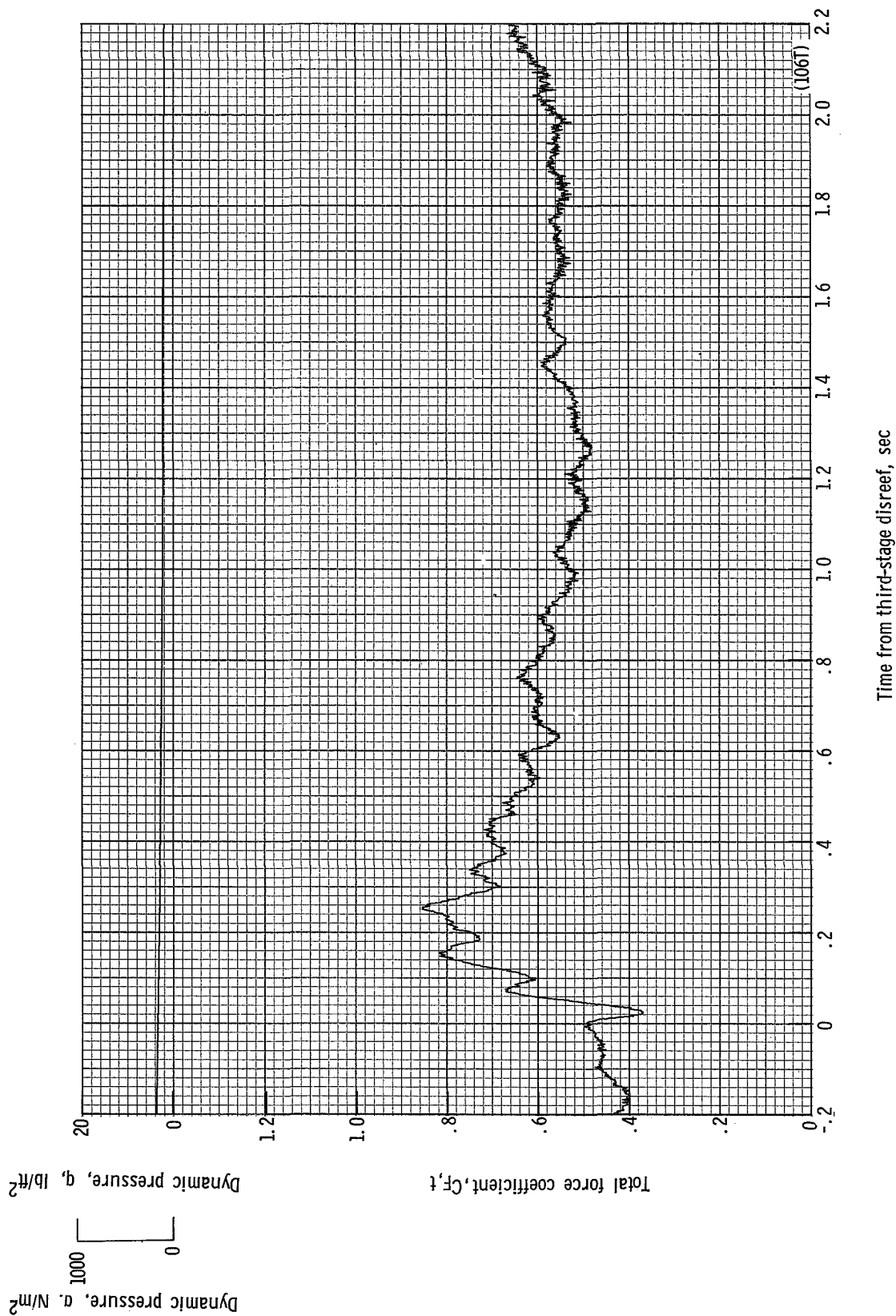
(r) Accelerations a_z , a_y , and a_x plotted against time from third-stage disreef. Time = 0 second corresponds to 40.87 seconds after launch.

Figure 28.- Continued.



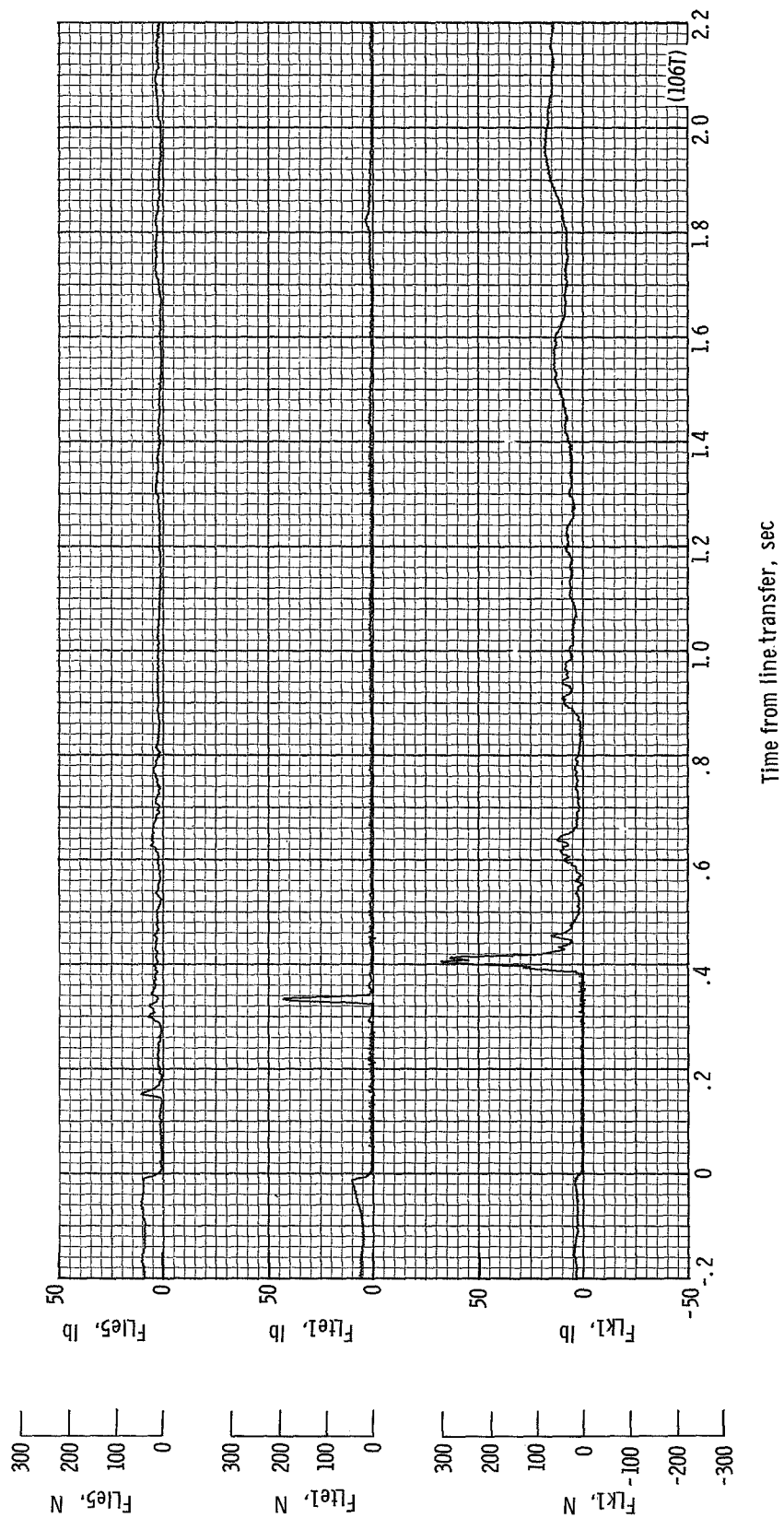
(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 40.87 seconds after launch.

Figure 28.- Continued.



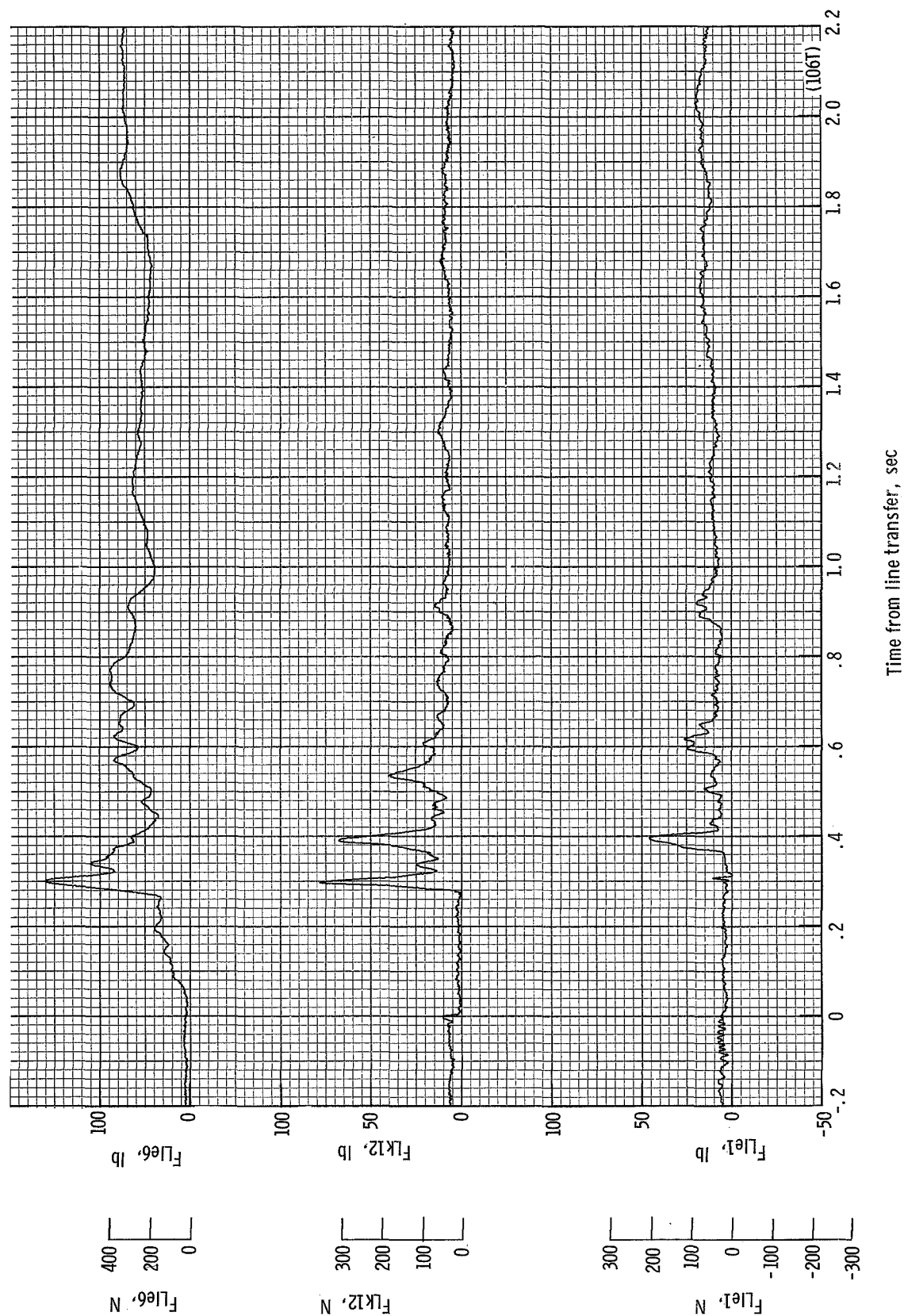
(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 40.87 seconds after launch.

Figure 28.- Continued.



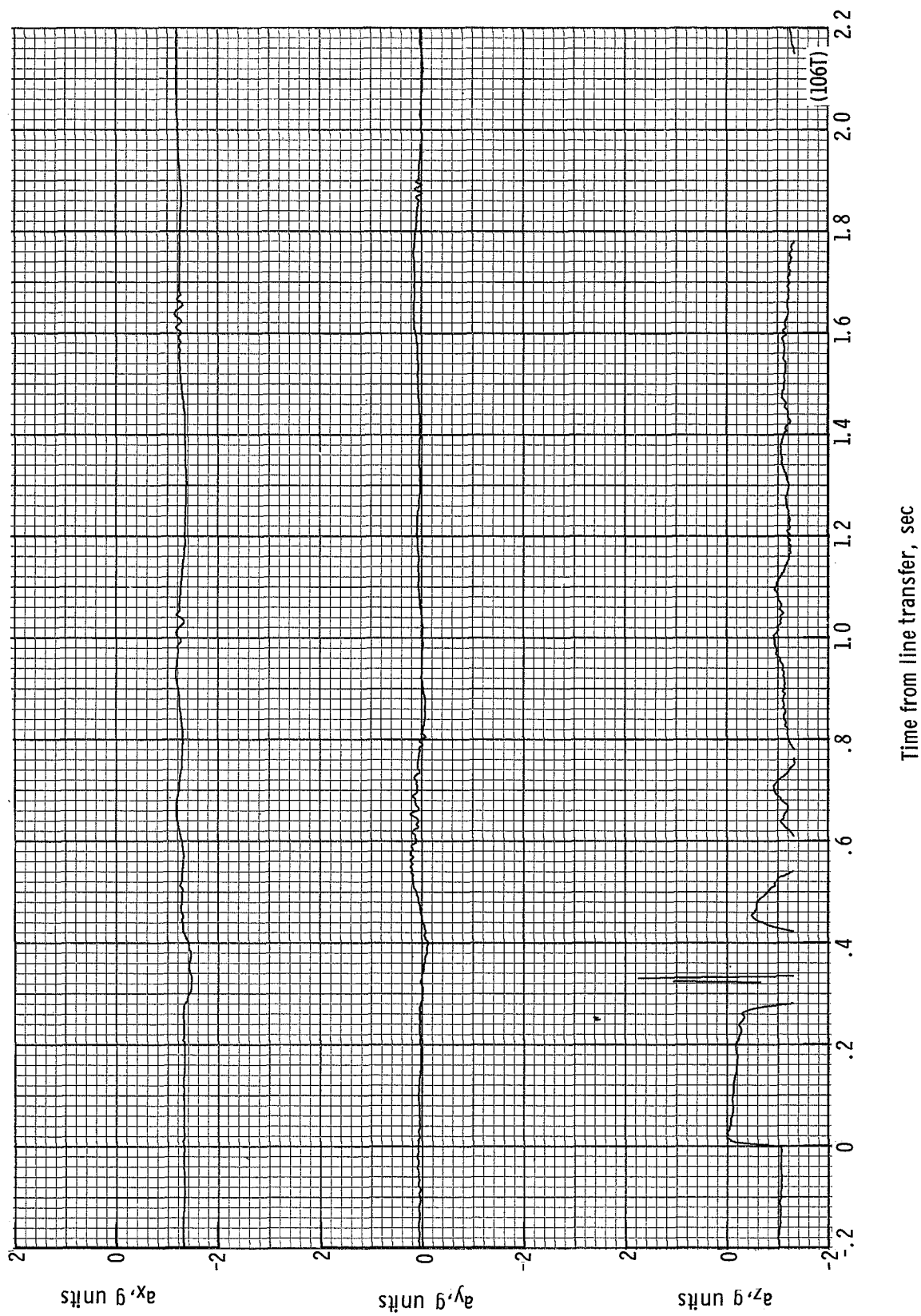
(u) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lte5} plotted against time from line transfer. Time = 0 second corresponds to 48.61 seconds after launch.

Figure 28.- Continued.



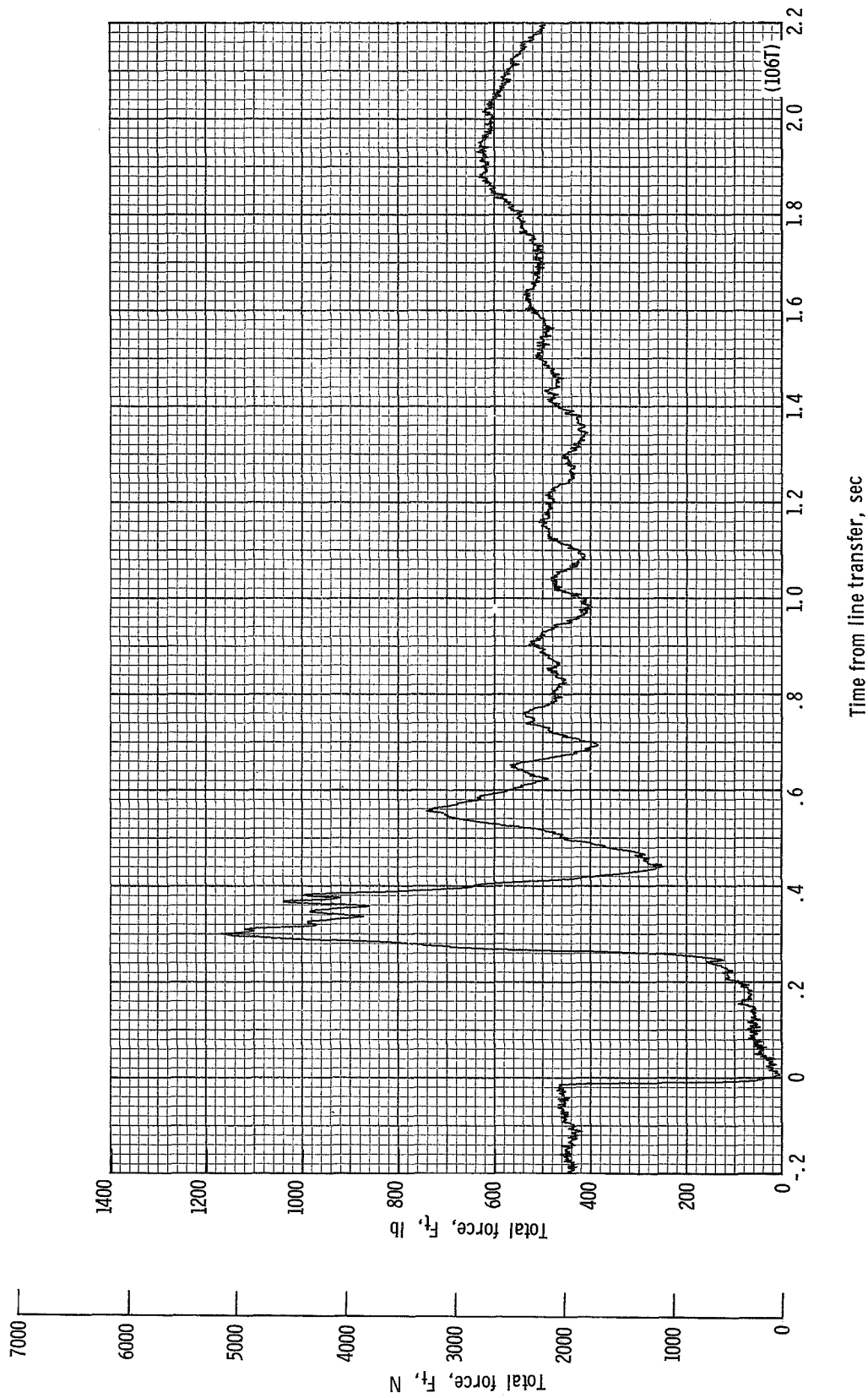
(v) Individual suspension-line loads F_{L1e1} , F_{LK12} , and F_{L1e6} plotted against time from line transfer. Time = 0 second corresponds to 48.61 seconds after launch.

Figure 28.- Continued.



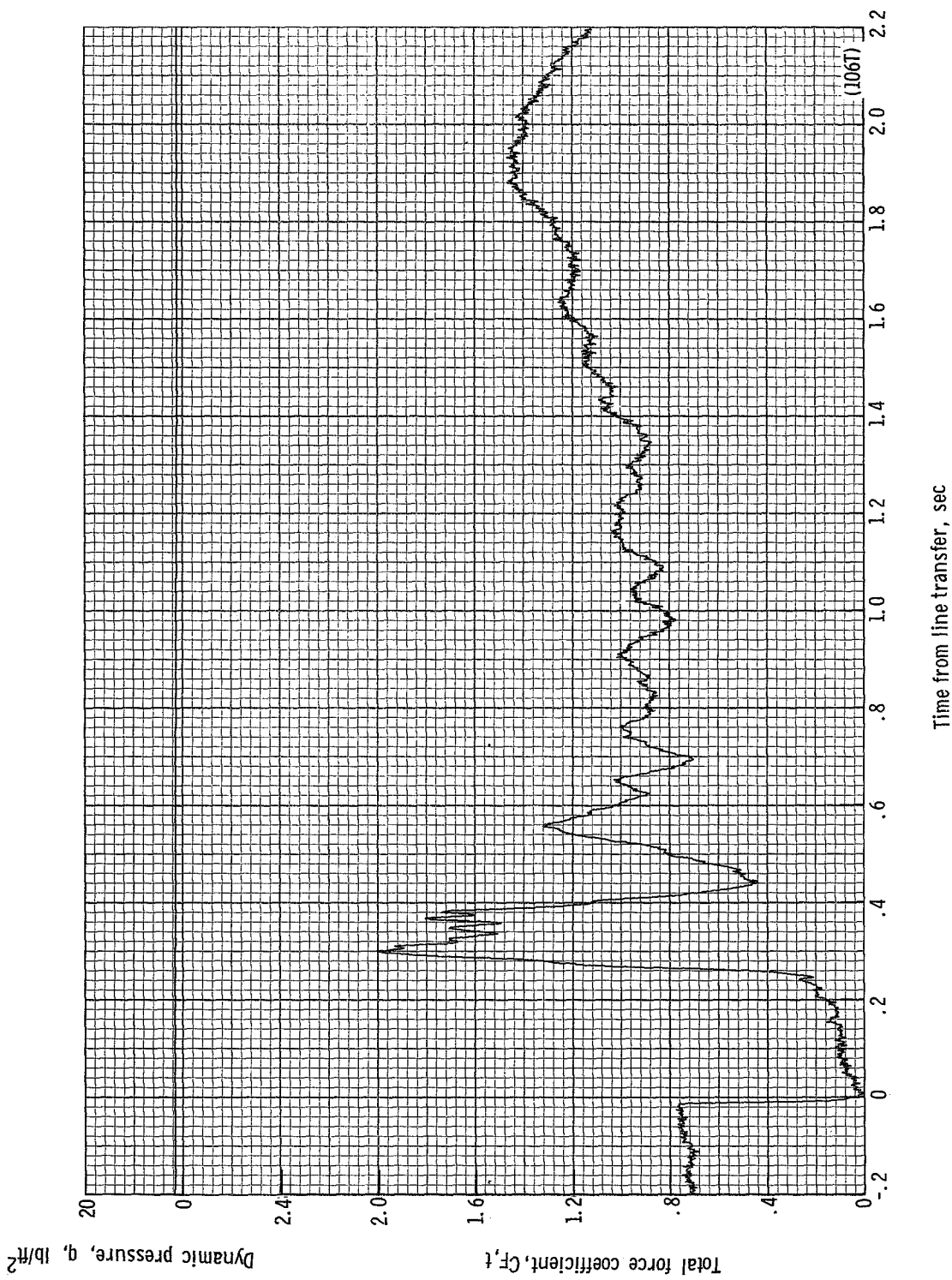
(w) Accelerations a_z , a_y , and a_x plotted against time from line transfer. Time = 0 second corresponds to 48.61 seconds after launch.

Figure 28.- Continued.



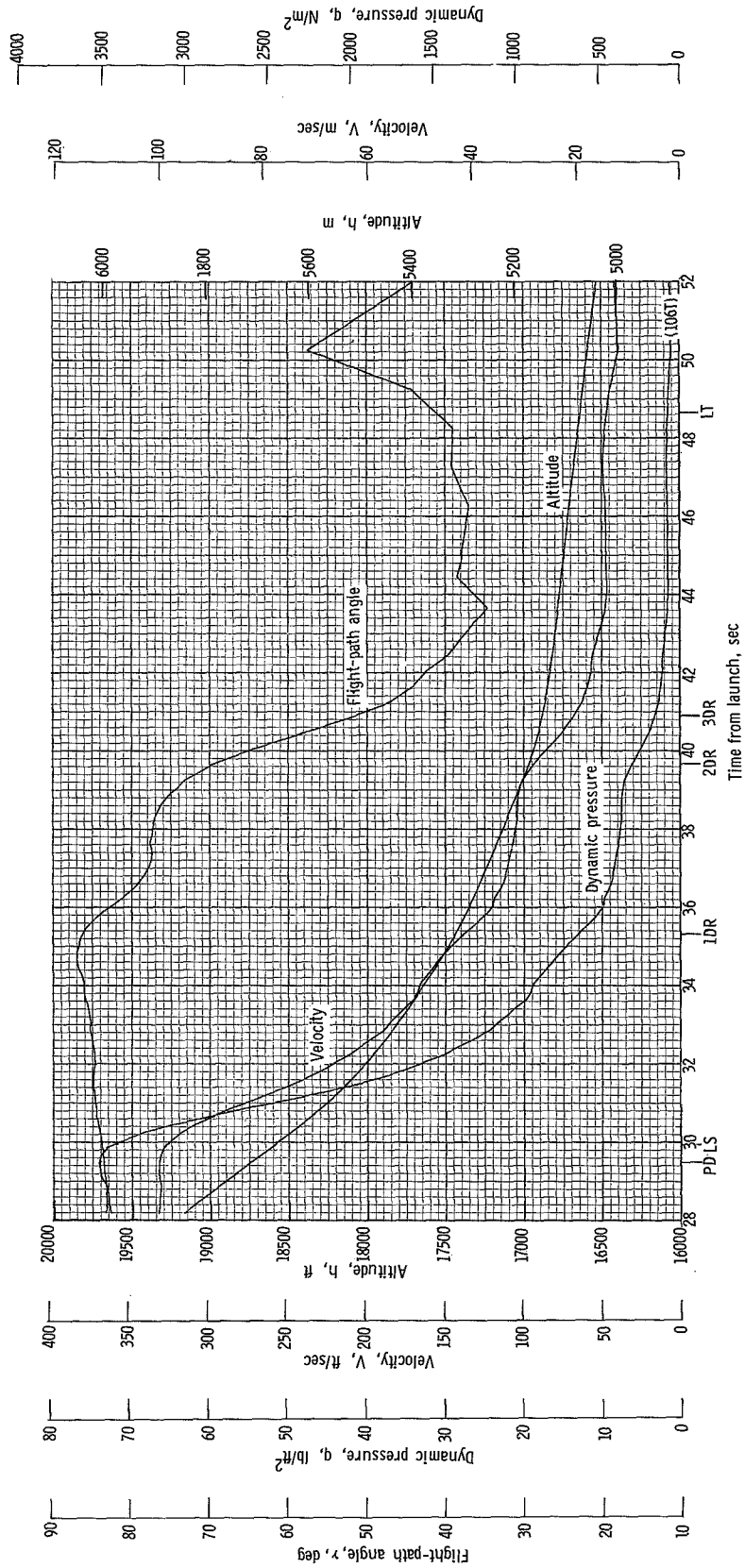
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 48.61 seconds after launch.

Figure 28.- Continued.



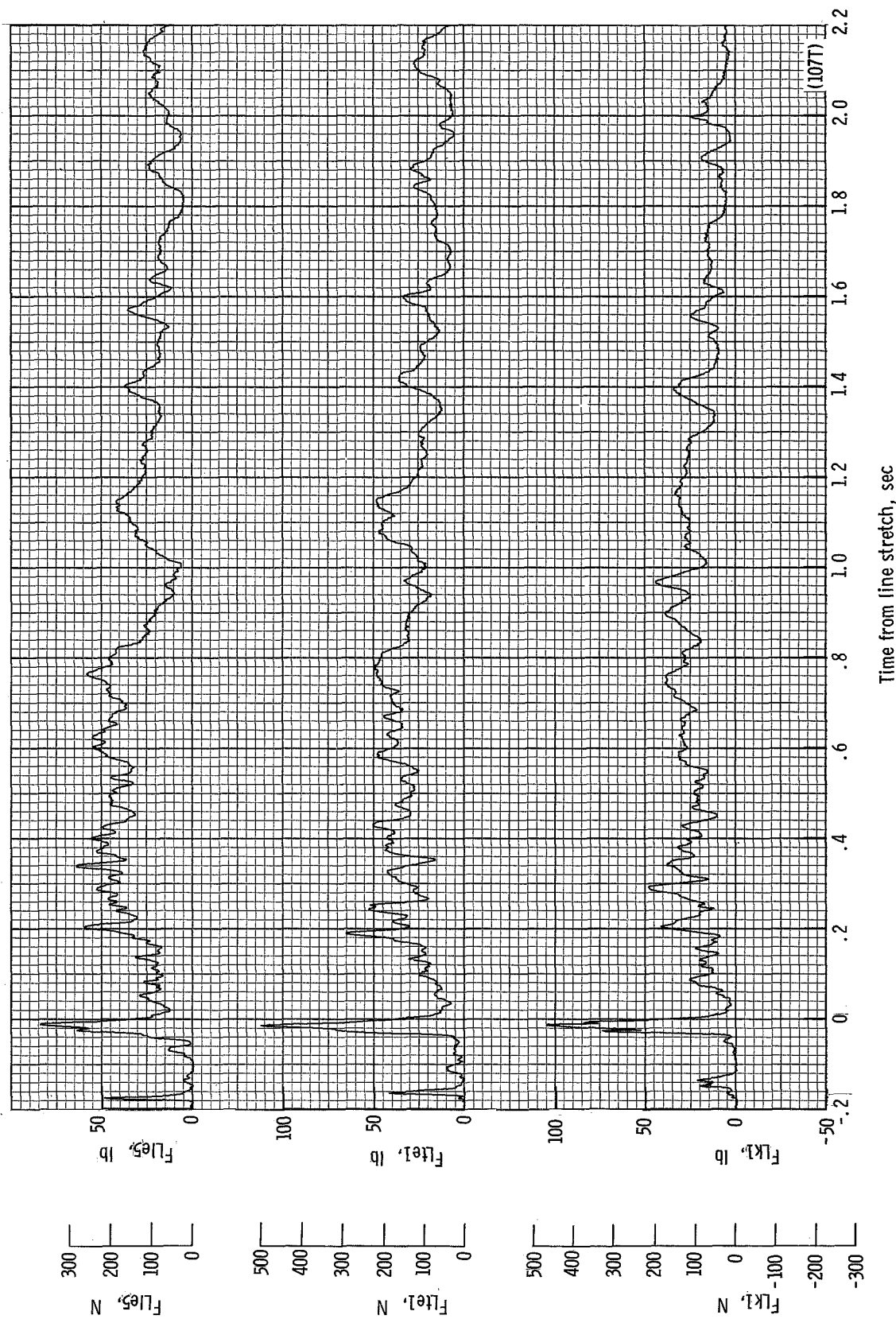
(v) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 48.61 seconds after launch.

Figure 28.- Continued.



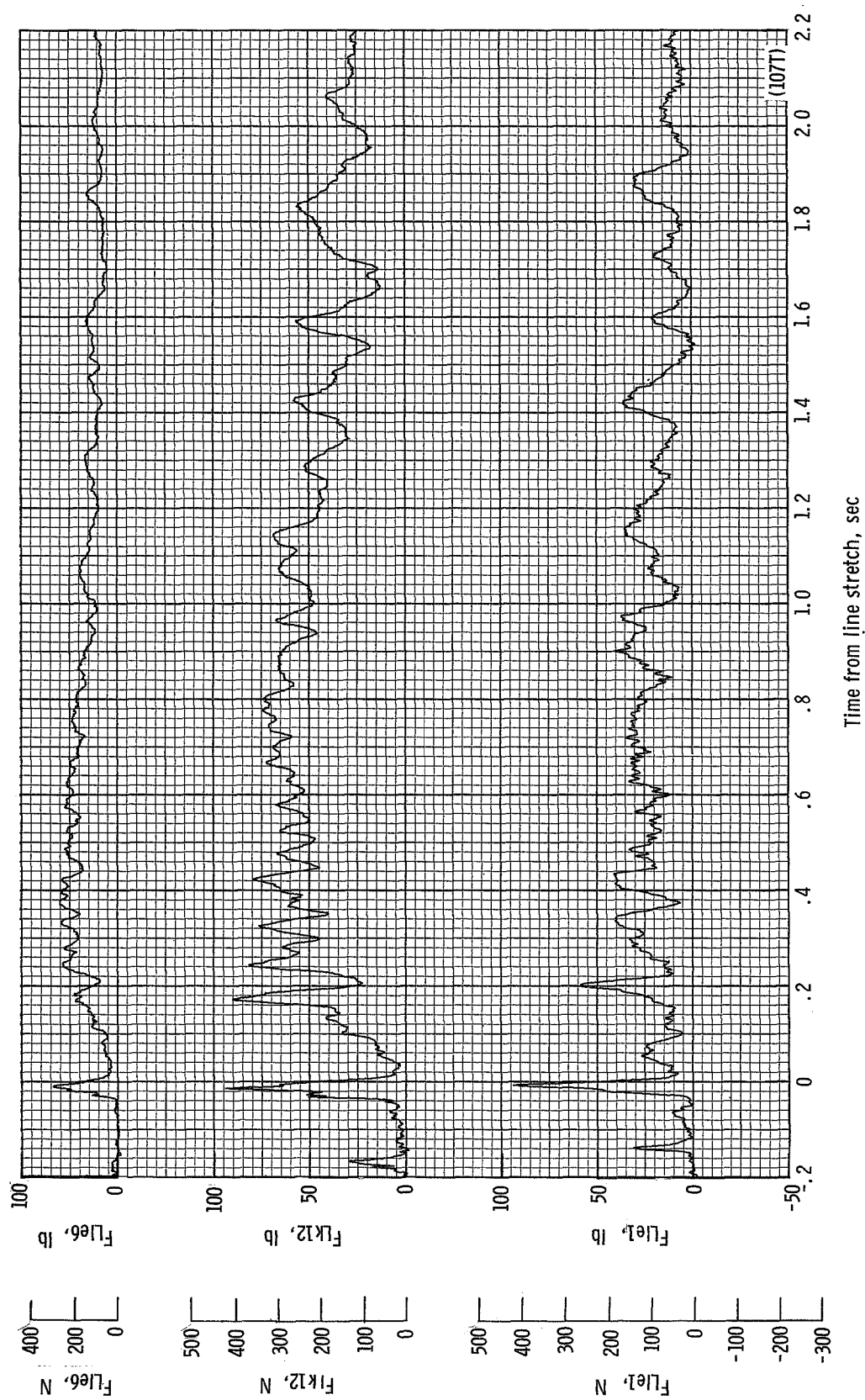
(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 28.- Concluded.



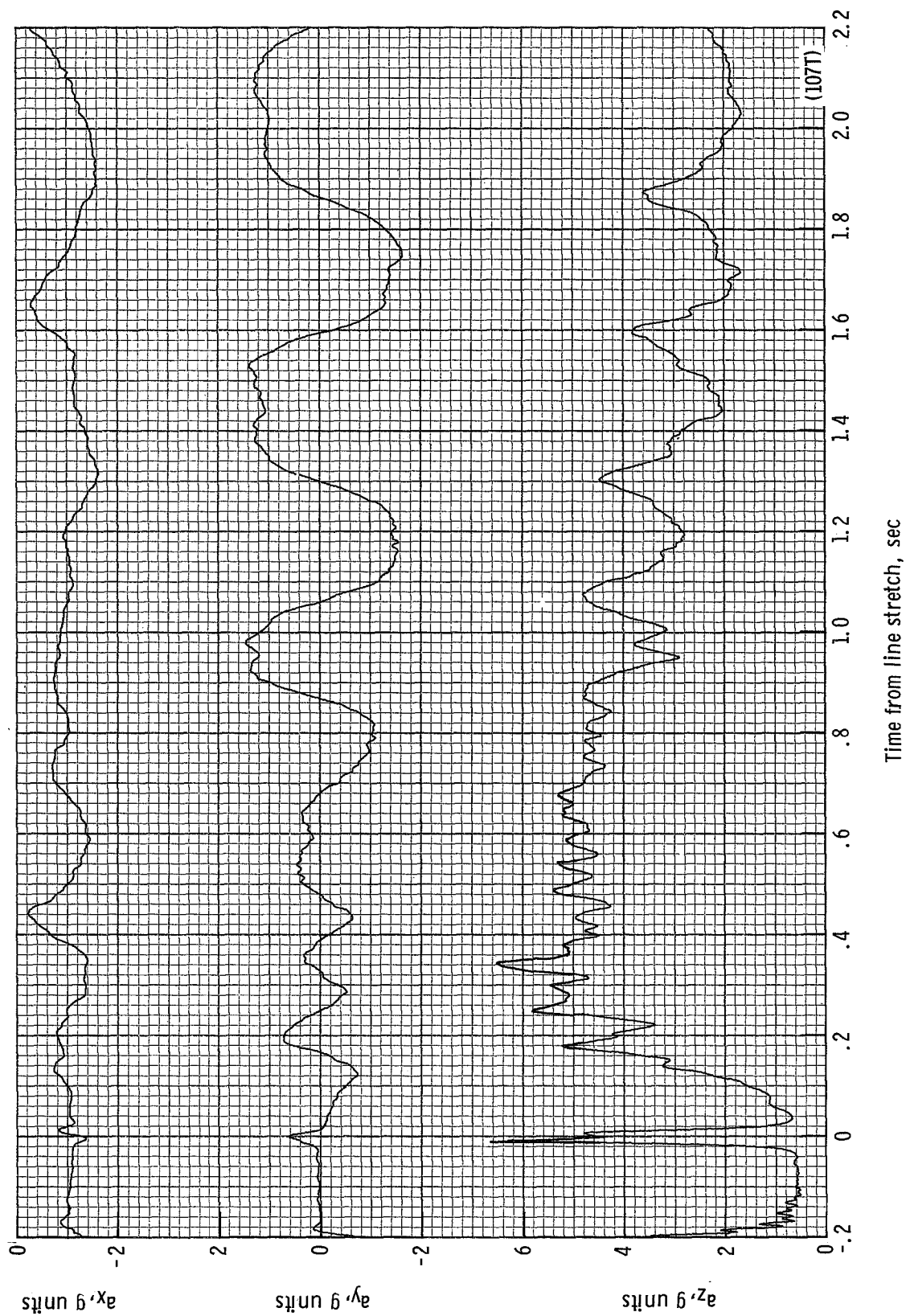
(a) Individual suspension-line loads F_{Lk1} , F_{Lie1} , and F_{Lie5} plotted against time from line stretch. Time = 0 second corresponds to 27.25 seconds after launch.

Figure 29: - Time history of twin-keel parawing deployment data for test 107T. $W_D = 2218.3 \text{ N}$ (498.7 lb); $W_P = 2063.5 \text{ N}$ (463.9 lb); $q_{PD} = 4457.7 \text{ N/m}^2$ (93.1 lb/ft²); $h_{PD} = 6136 \text{ m}$ (20 130 ft); $t_r/t_k = 0.153$; reefing version 1.



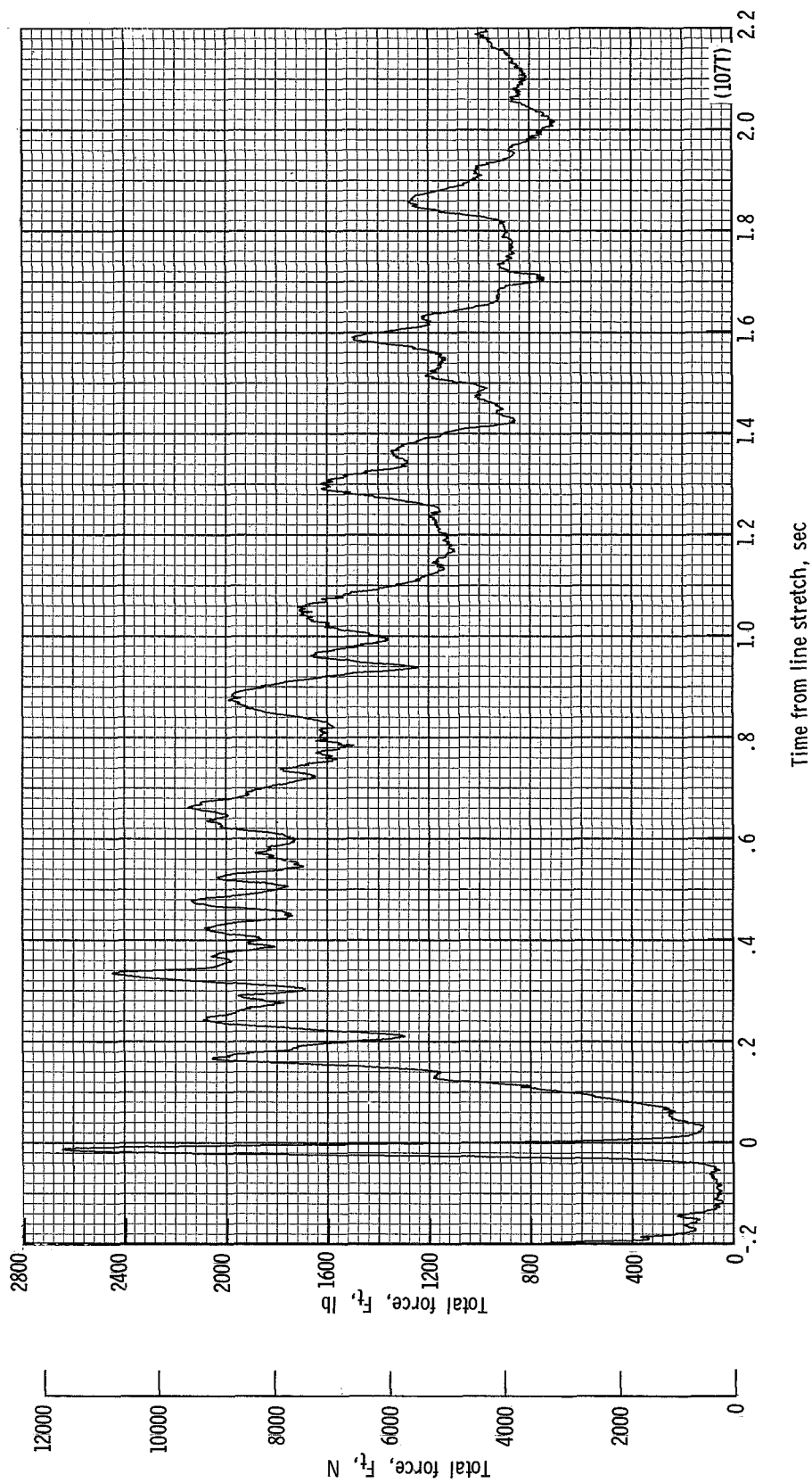
(b) Individual suspension-line loads F_{L1e1} , F_{L12} , and F_{L1e6} plotted against time from line stretch. Time = 0 second corresponds to 27.25 seconds after launch.

Figure 29.- Continued.



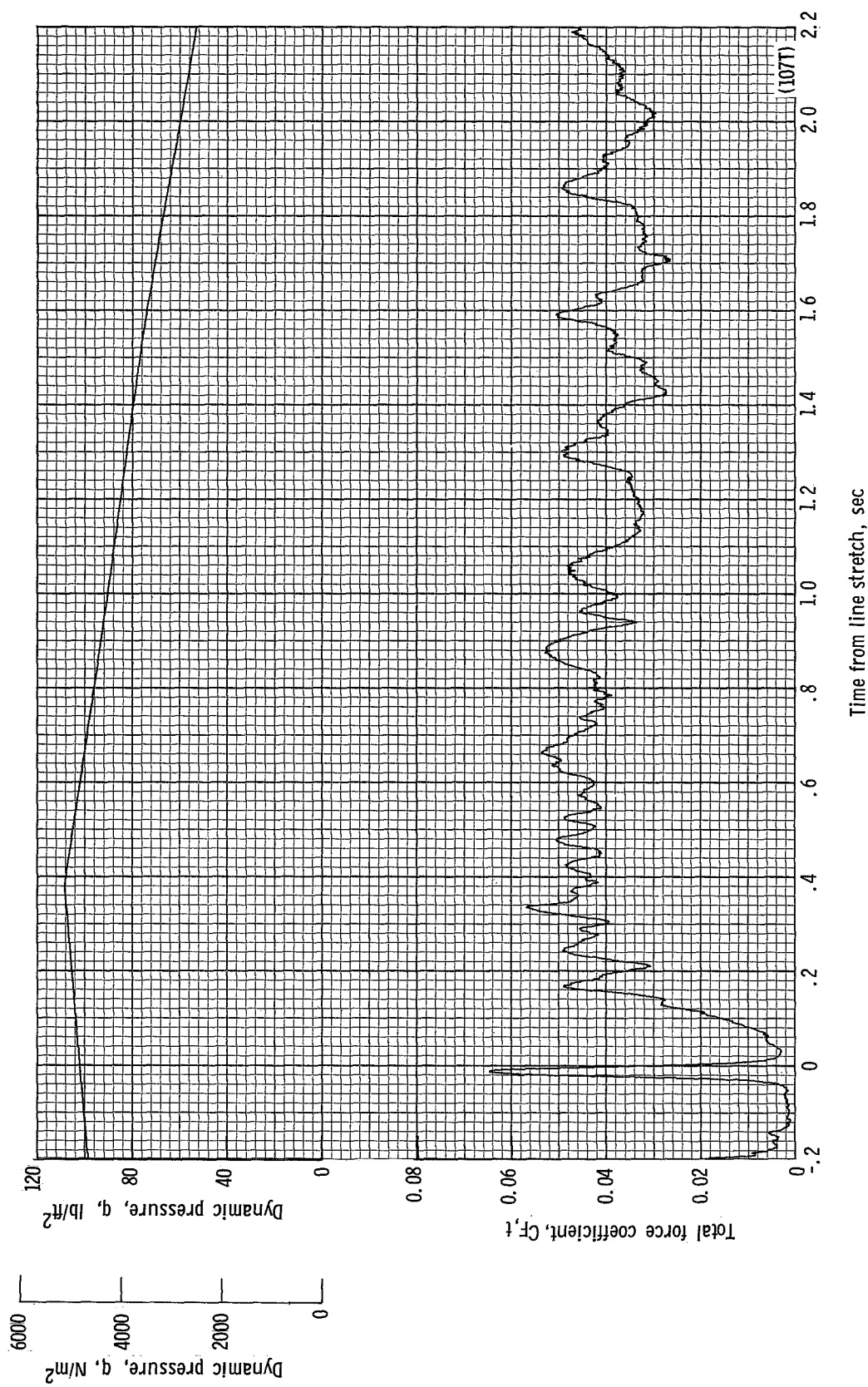
(c) Accelerations a_z , a_y , and a_x plotted against time from line stretch. Time = 0 second corresponds to 27.25 seconds after launch.

Figure 29.- Continued.



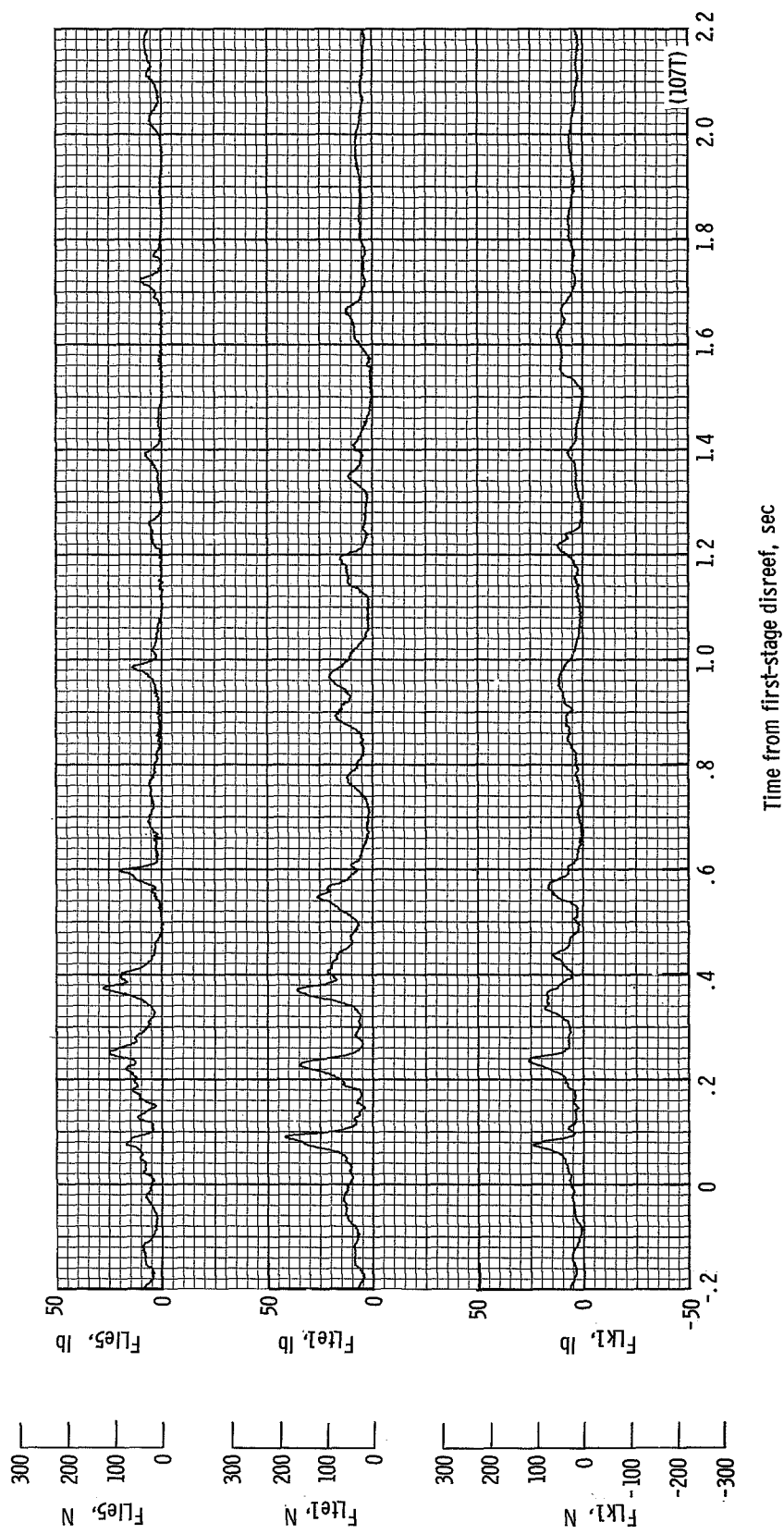
(d) Total force F_t plotted against time from line stretch. Time = 0 second corresponds to 27.25 seconds after launch.

Figure 29.- Continued.



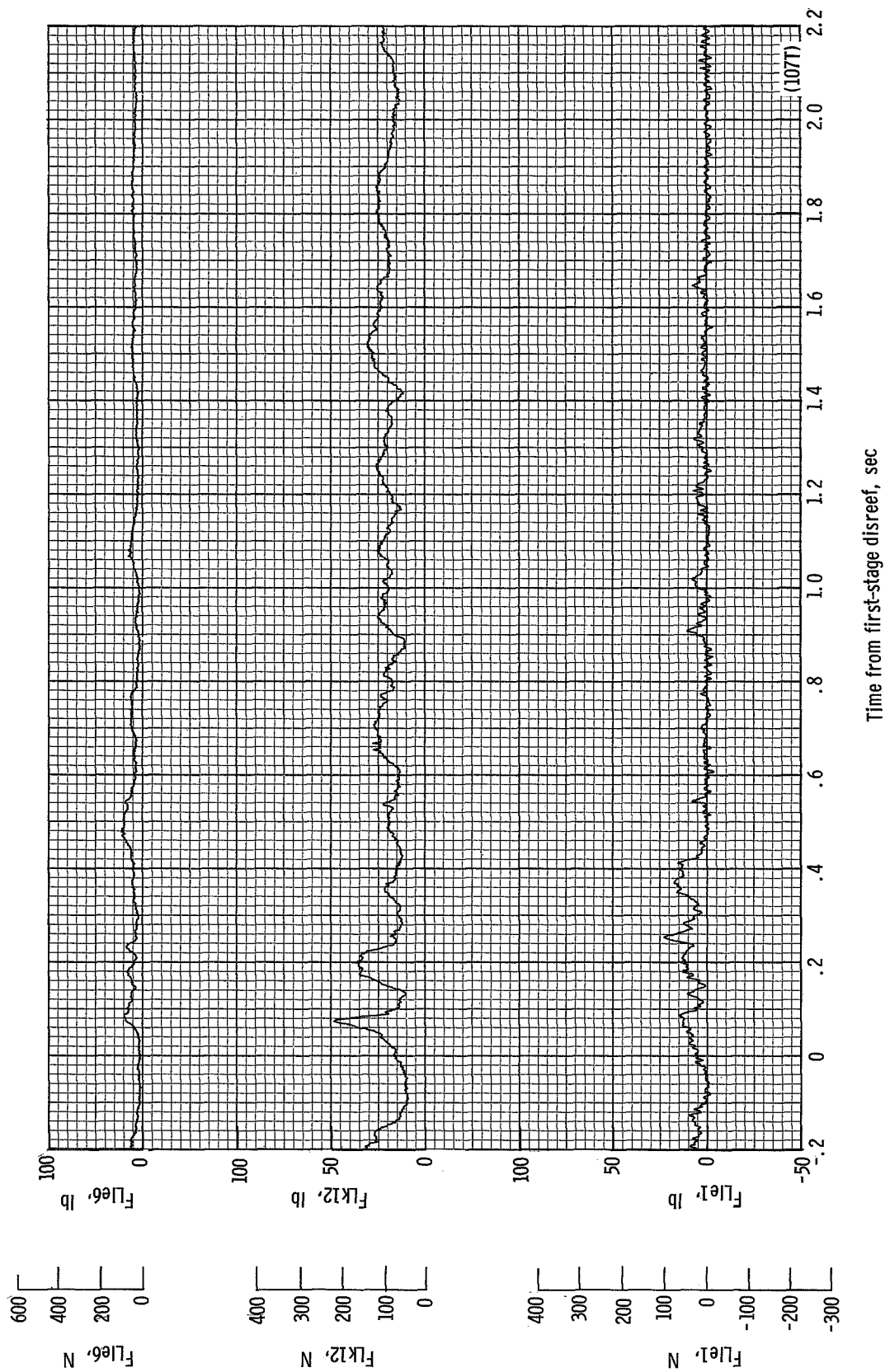
(e) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line stretch. Time = 0 second corresponds to 27.25 seconds after launch.

Figure 29.- Continued.



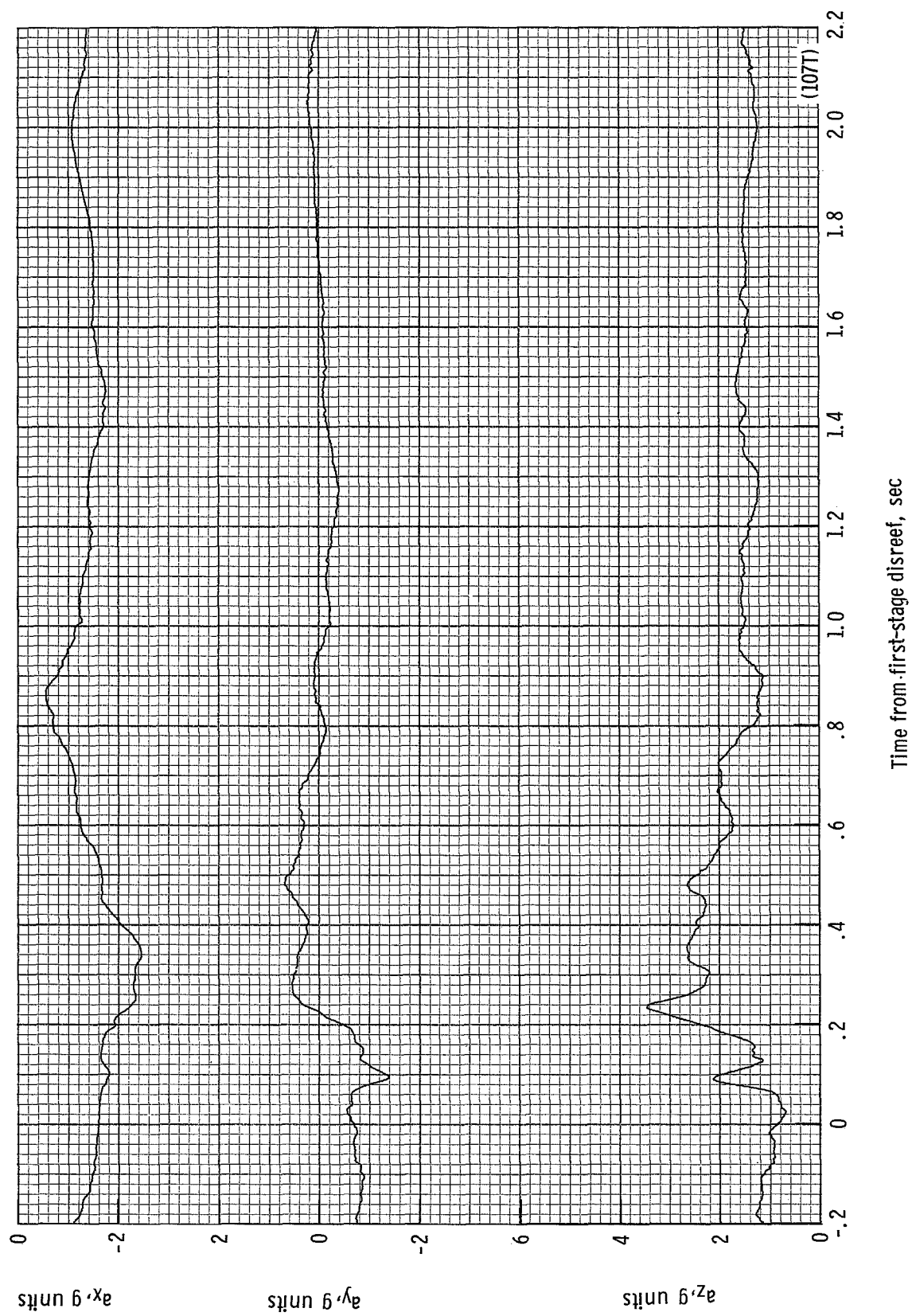
(f) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lte5} plotted against time from first-stage disreef. Time = 0 second corresponds to 32.72 seconds after launch.

Figure 29.- Continued.



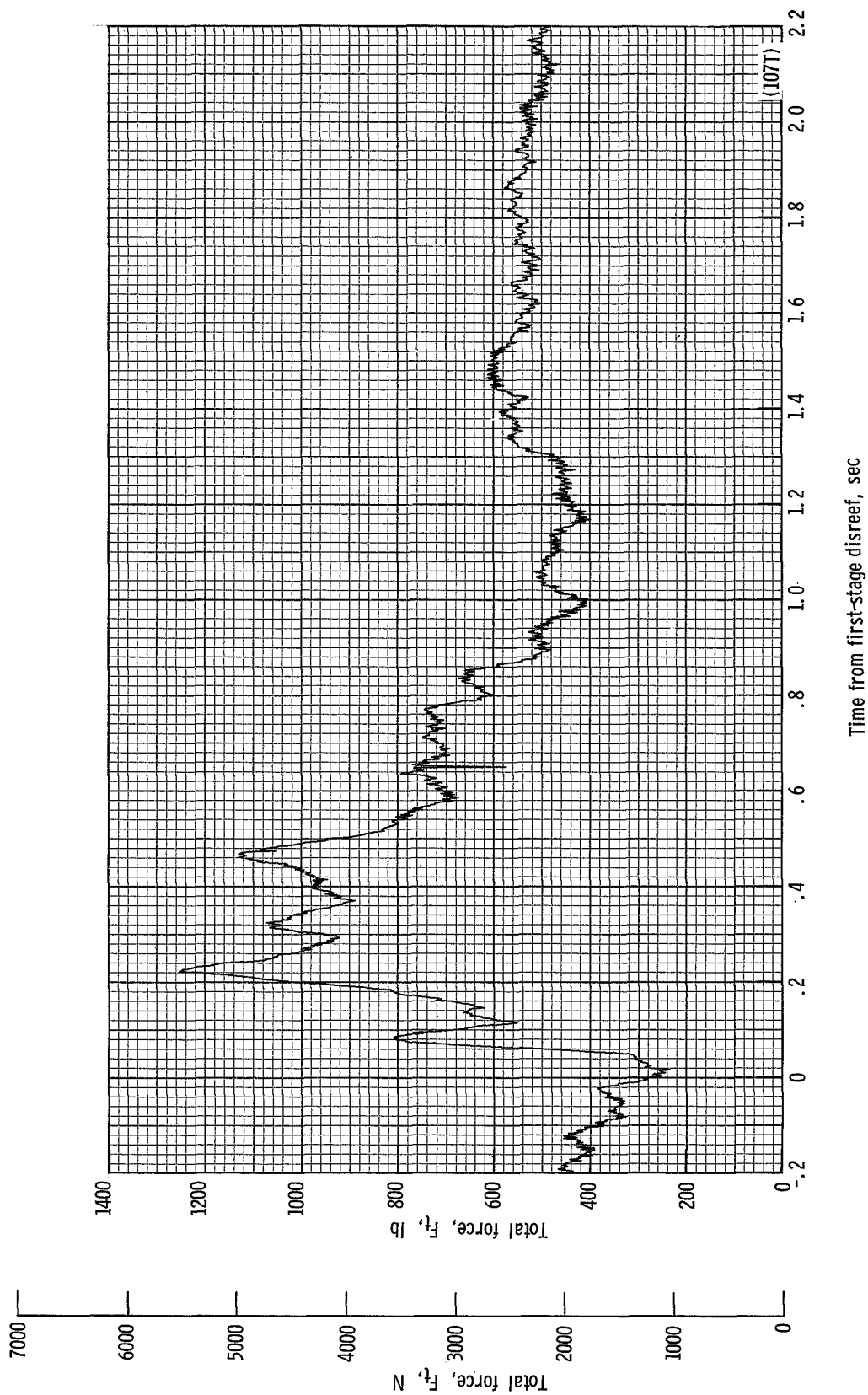
(g) Individual suspension-line loads F_{Lie1} , F_{LK12} , and F_{Lie6} plotted against time from first-stage disreef. Time = 0 second corresponds to 32.72 seconds after launch.

Figure 29.- Continued.



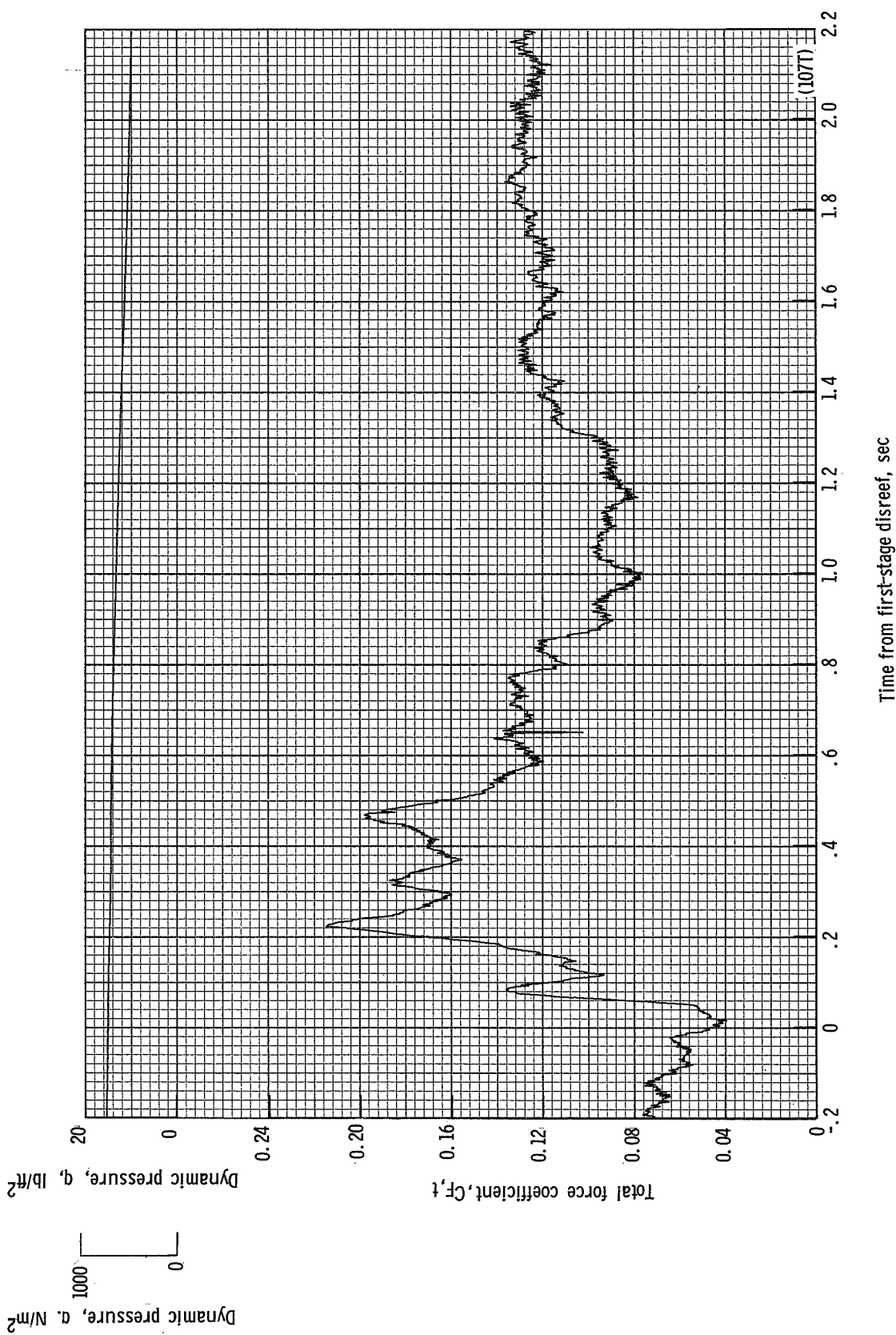
(h) Accelerations a_z , a_y , and a_x plotted against time from first-stage disreef. Time = 0 second corresponds to 32.72 seconds after launch.

Figure 29.- Continued.



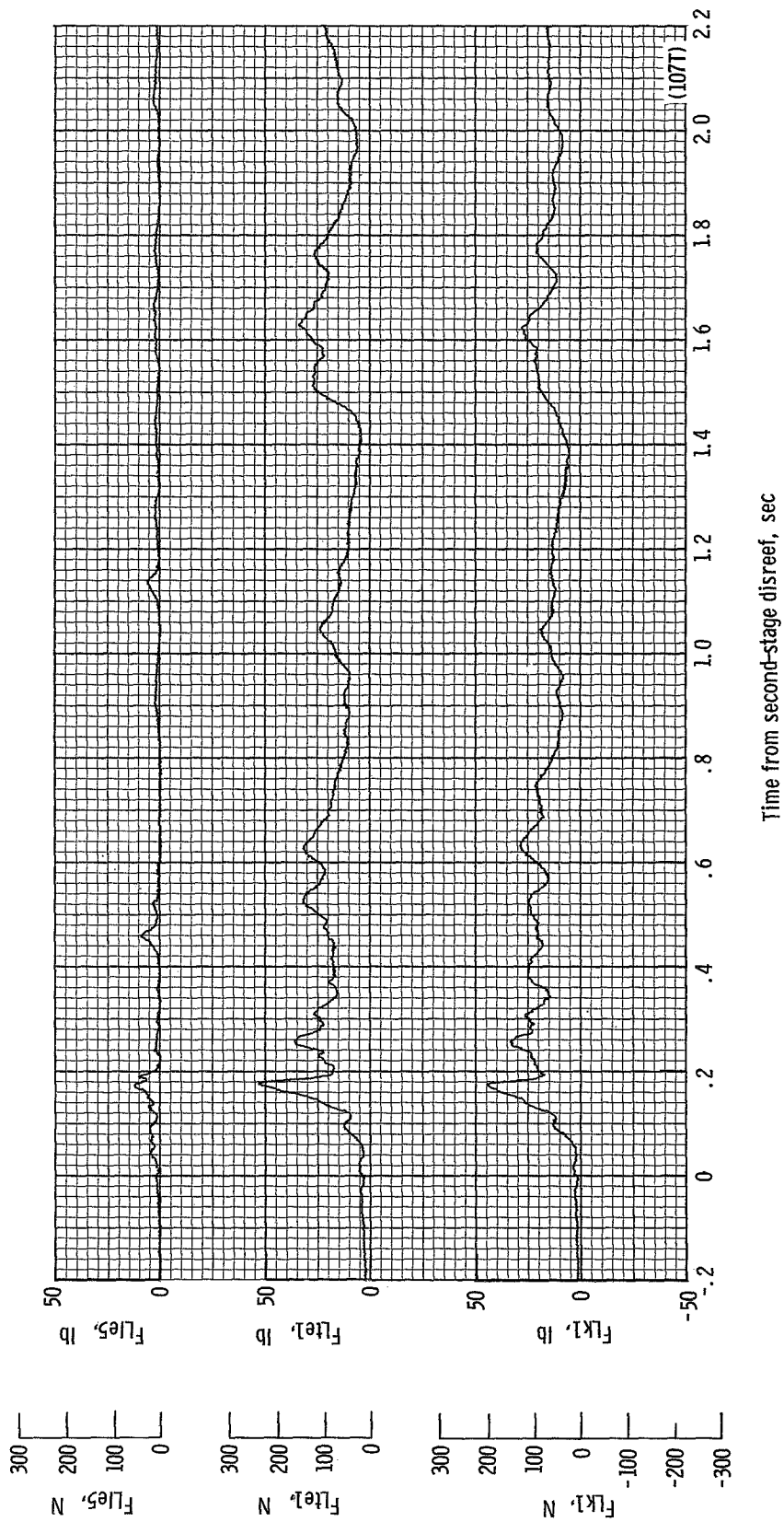
(i) Total force F_t plotted against time from first-stage disreef. Time = 0 second corresponds to 32.72 seconds after launch.

Figure 29.- Continued.

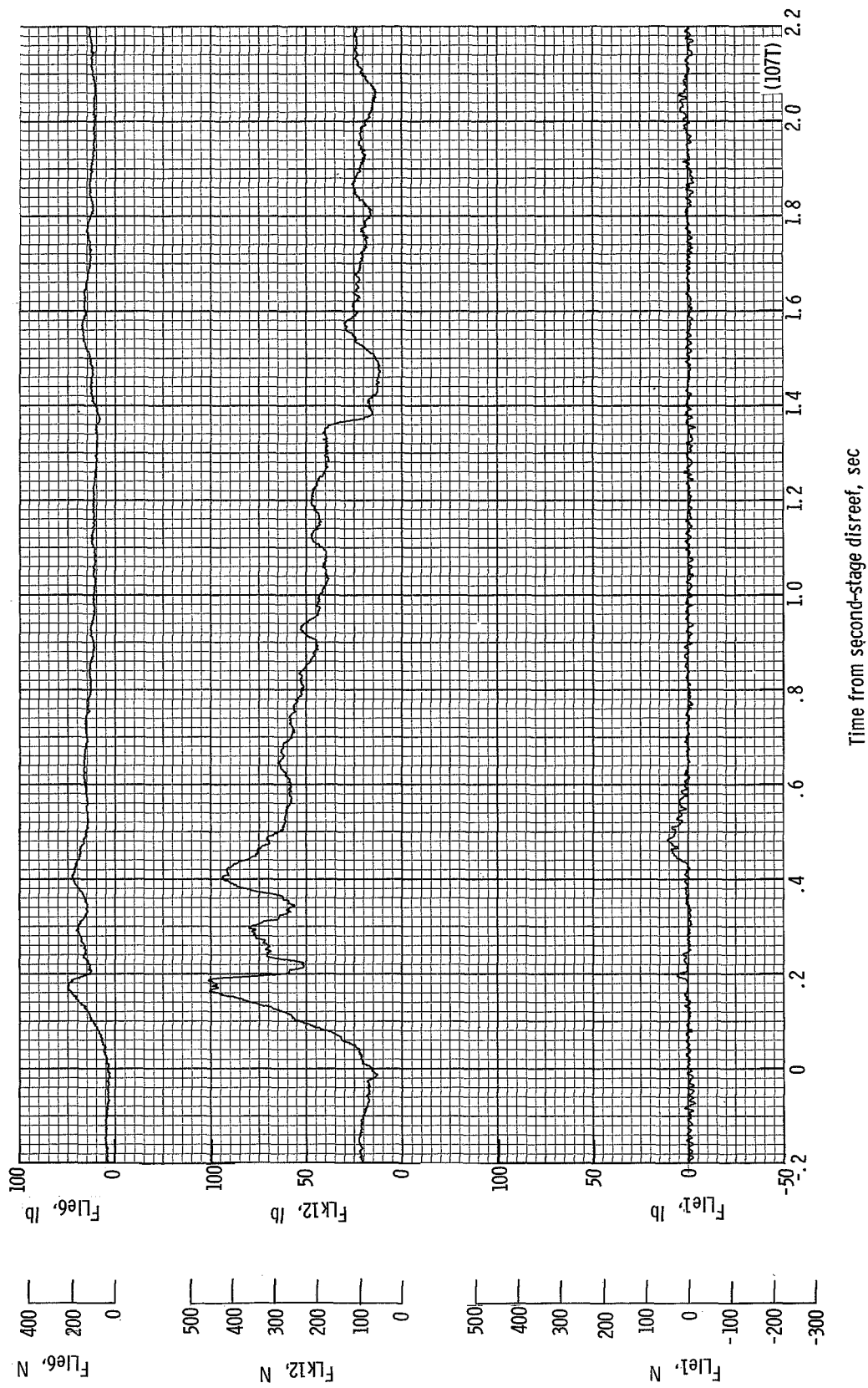


(j) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from first-stage disreef. Time = 0 second corresponds to 32.72 seconds after launch.

Figure 29.- Continued.

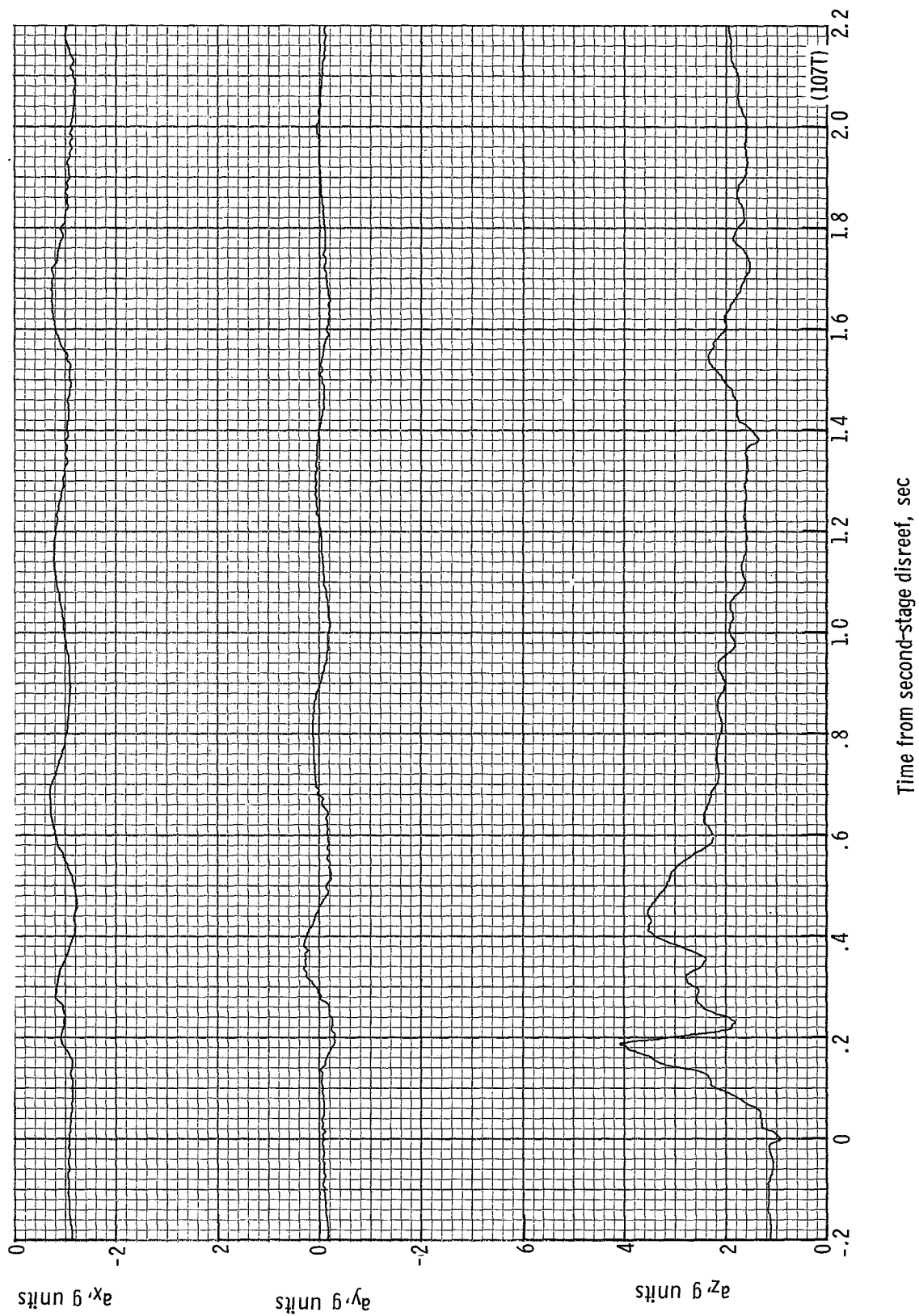


(k) Individual suspension-line loads F_{Lk1} , F_{Lte1} , and F_{Lle5} plotted against time from second-stage disreef. Time = 0 second corresponds to 36.92 seconds after launch.
Figure 29.- Continued.



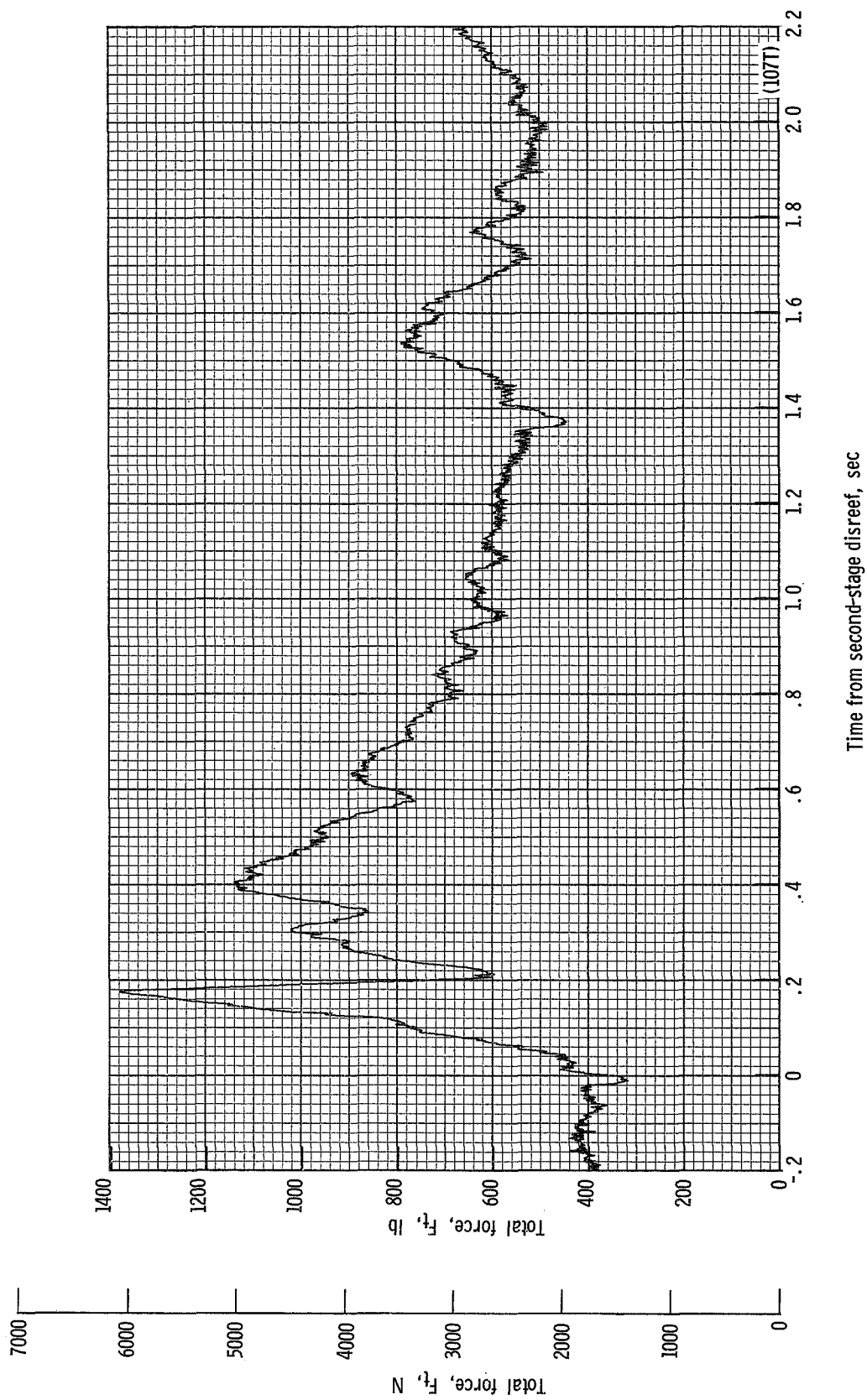
(1) Individual suspension-line loads F_{Lie1} , F_{Lk12} , and F_{Lie6} plotted against time from second-stage disreef. Time = 0 second corresponds to 36.92 seconds after launch.

Figure 29.- Continued.



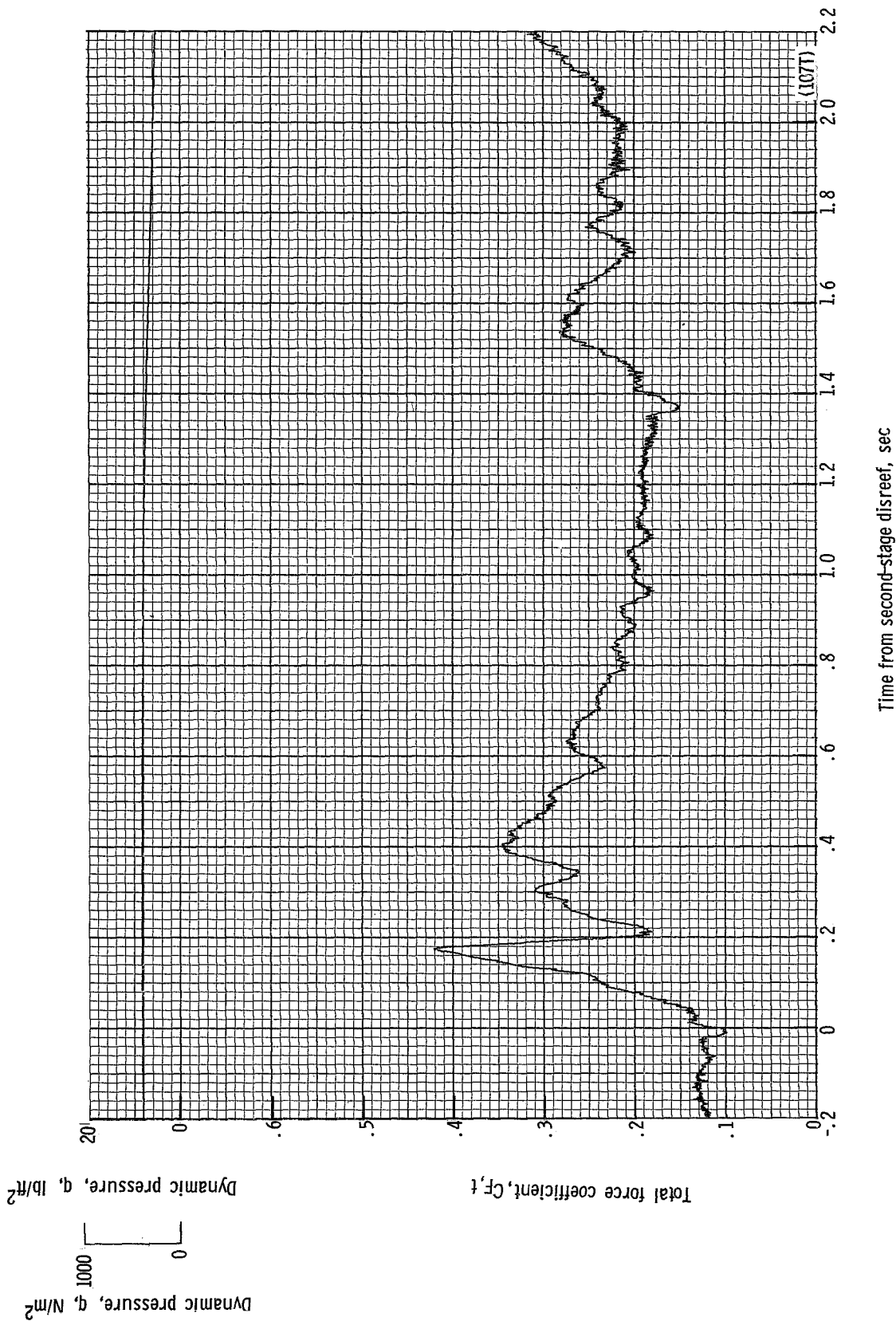
(m) Accelerations a_z , a_y , and a_x plotted against time from second-stage disreef. Time = 0 second corresponds to 36.92 seconds after launch.

Figure 29.- Continued.



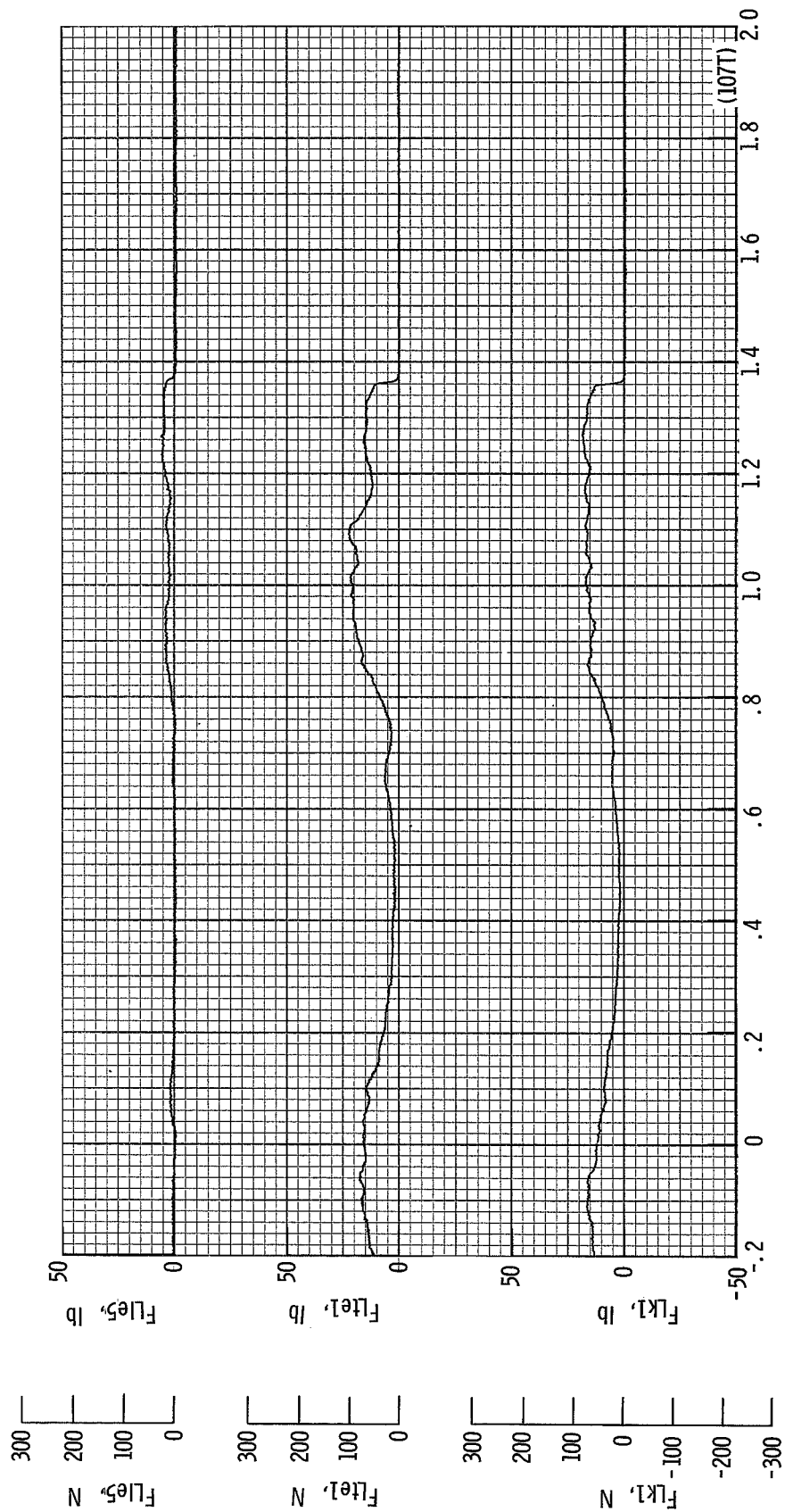
(n) Total force F_t plotted against time from second-stage disreef. Time = 0 second corresponds to 36.92 seconds after launch.

Figure 29.- Continued.



(c) Total force coefficient $C_{f,t}$ and dynamic pressure q plotted against time from second-stage disreef. Time = 0 second corresponds to 36.92 seconds after launch.

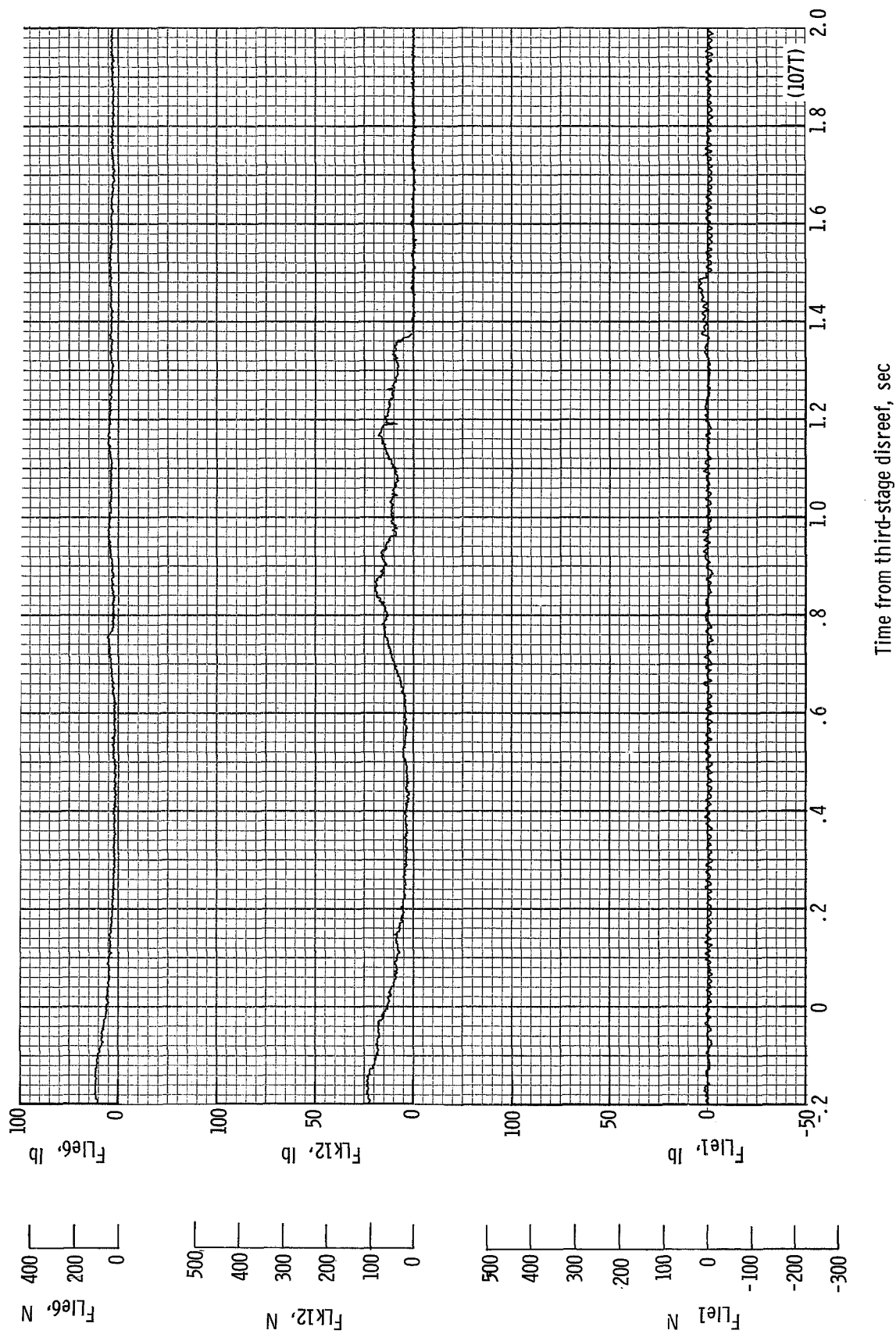
Figure 29.- Continued.



Time from third-stage disreef, sec

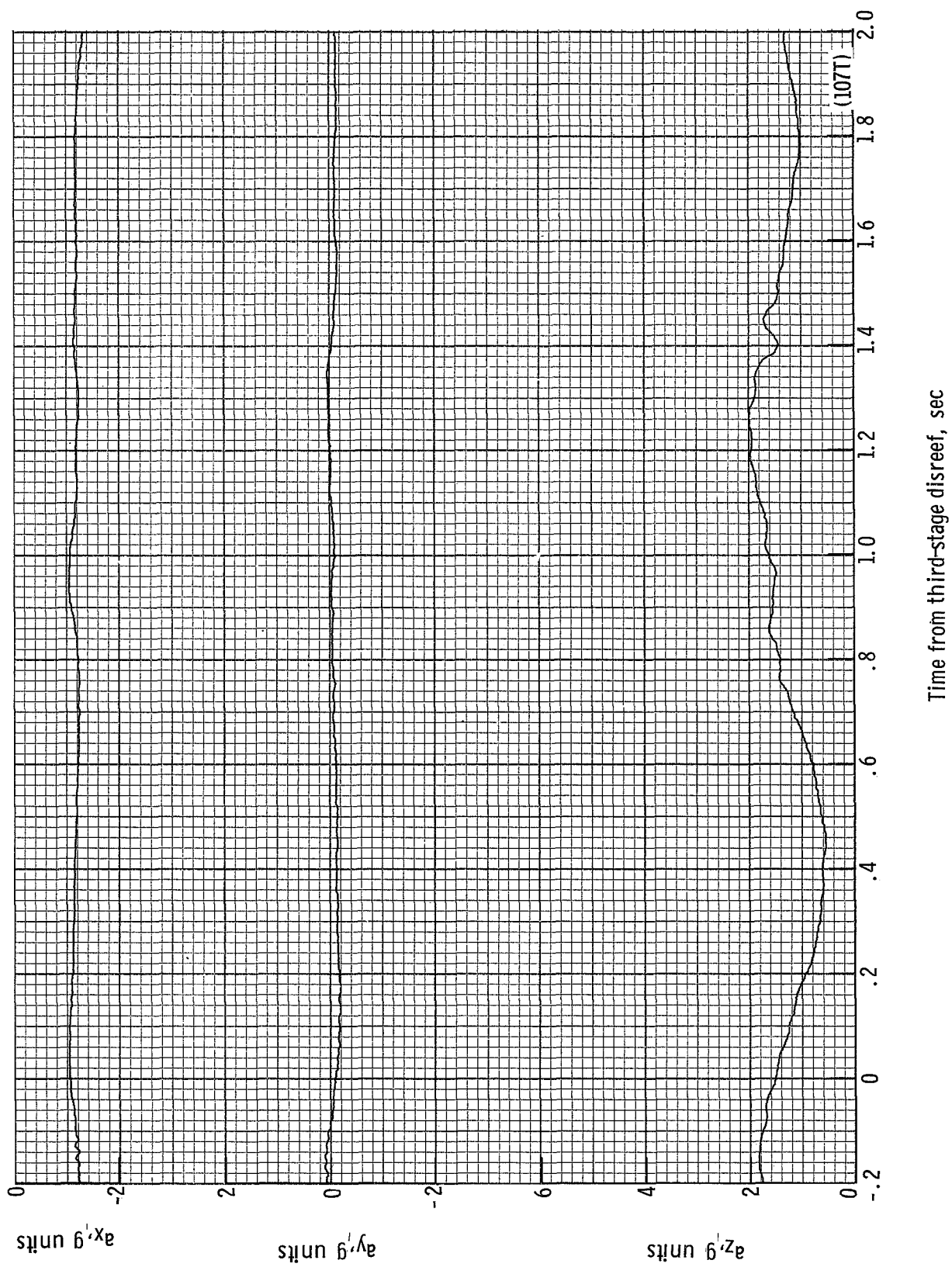
(p) Individual suspension-line loads $F[k1]$, $F[lte1]$, and $F[lte5]$ plotted against time from third-stage disreef. Time = 0 second corresponds to 40.79 seconds after launch.

Figure 29.- Continued.



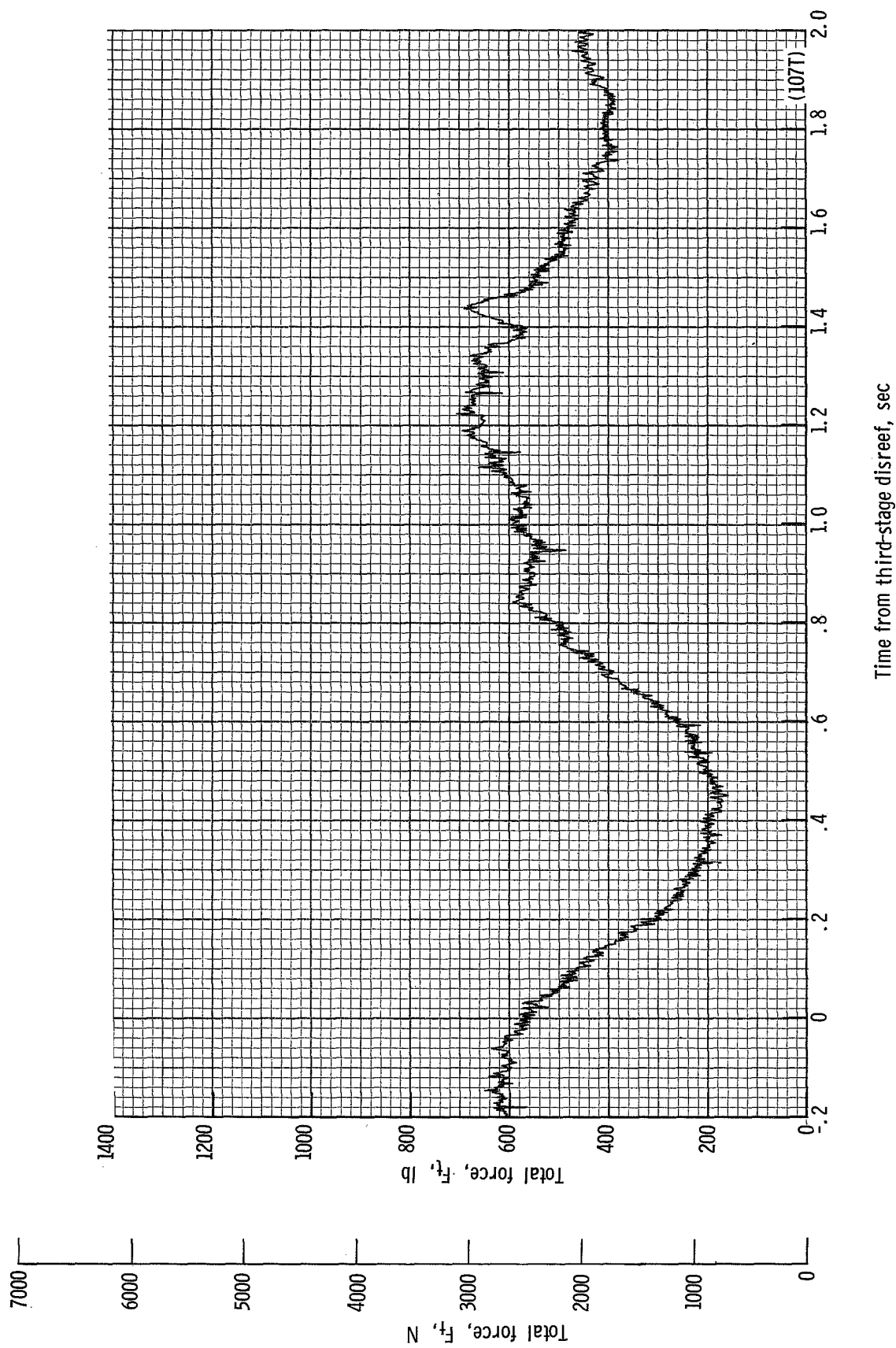
(q) Individual suspension-line loads F_{Le1} , $FLK12$, and F_{Le6} plotted against time from third-stage disreef. Time = 0 second corresponds to 40.79 seconds after launch.

Figure 29.- Continued.



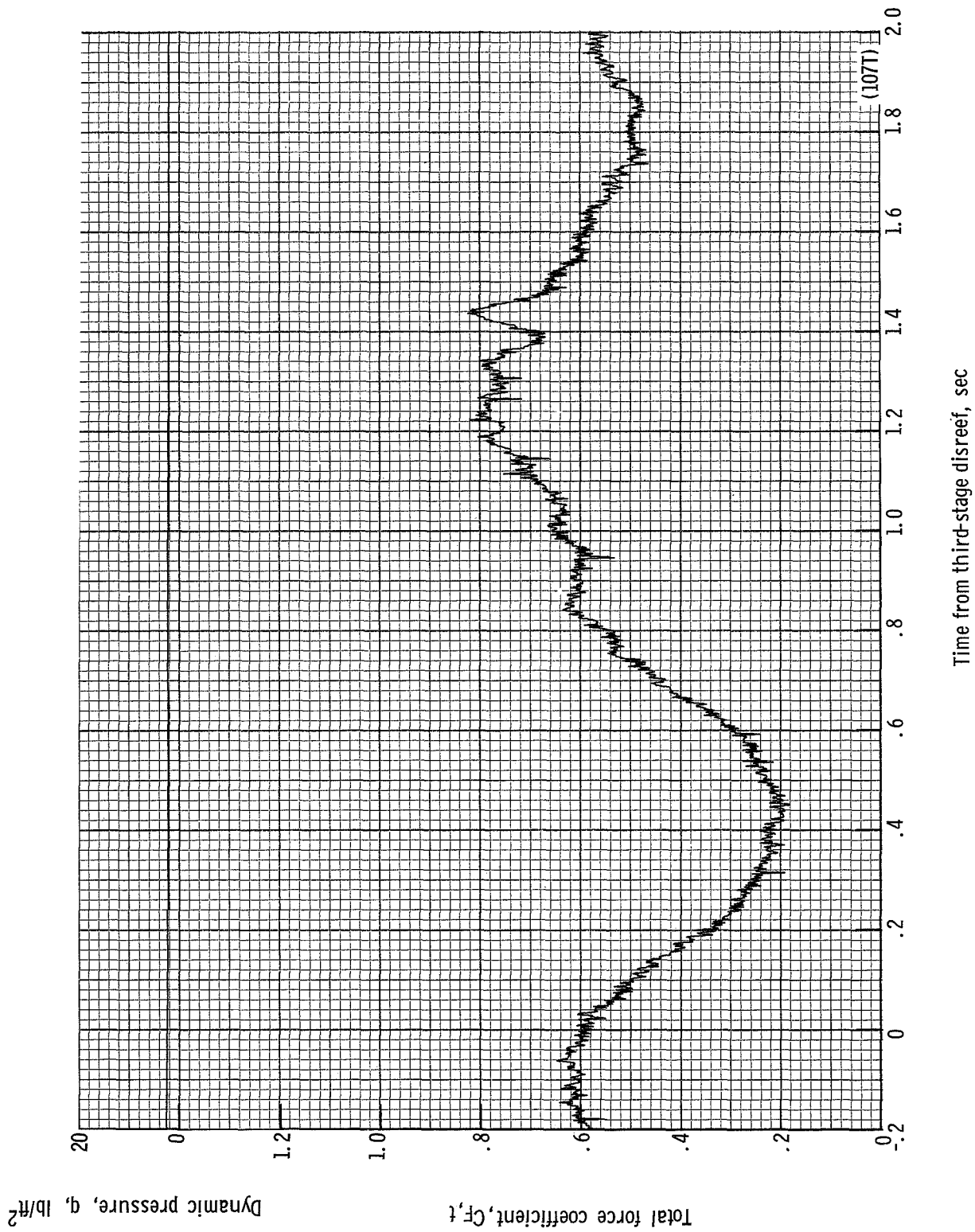
(r) Accelerations a_z , a_y , and a_x plotted against time from third-stage disreef. Time = 0 second corresponds to 40.79 seconds after launch.

Figure 29.- Continued.



(s) Total force F_t plotted against time from third-stage disreef. Time = 0 second corresponds to 40.79 seconds after launch.

Figure 29.- Continued.



(t) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from third-stage disreef. Time = 0 second corresponds to 40.79 seconds after launch.

Figure 29.- Continued.

F_{Lle5} , N

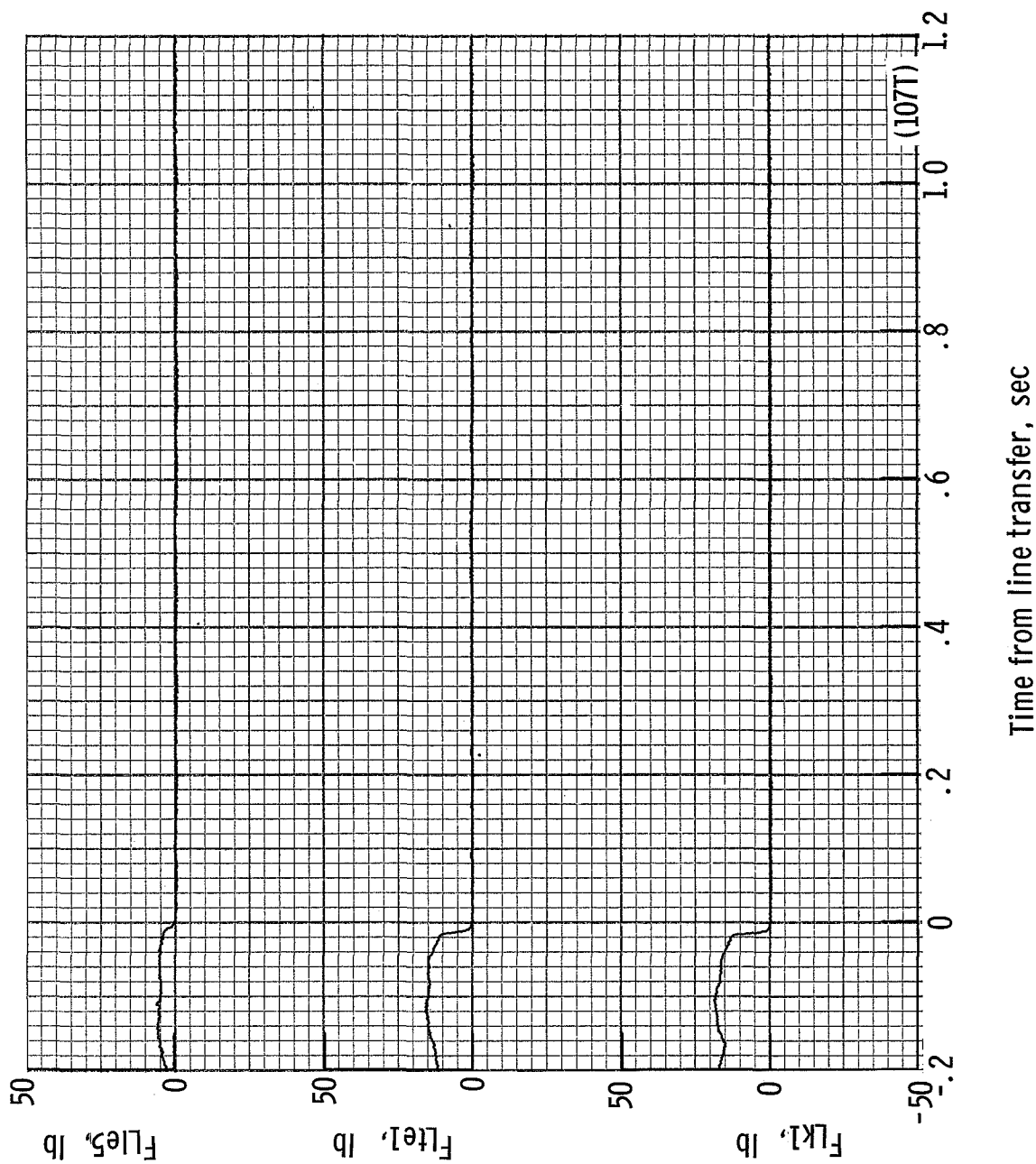
300
200
100
0

F_{Lle1} , N

300
200
100
0

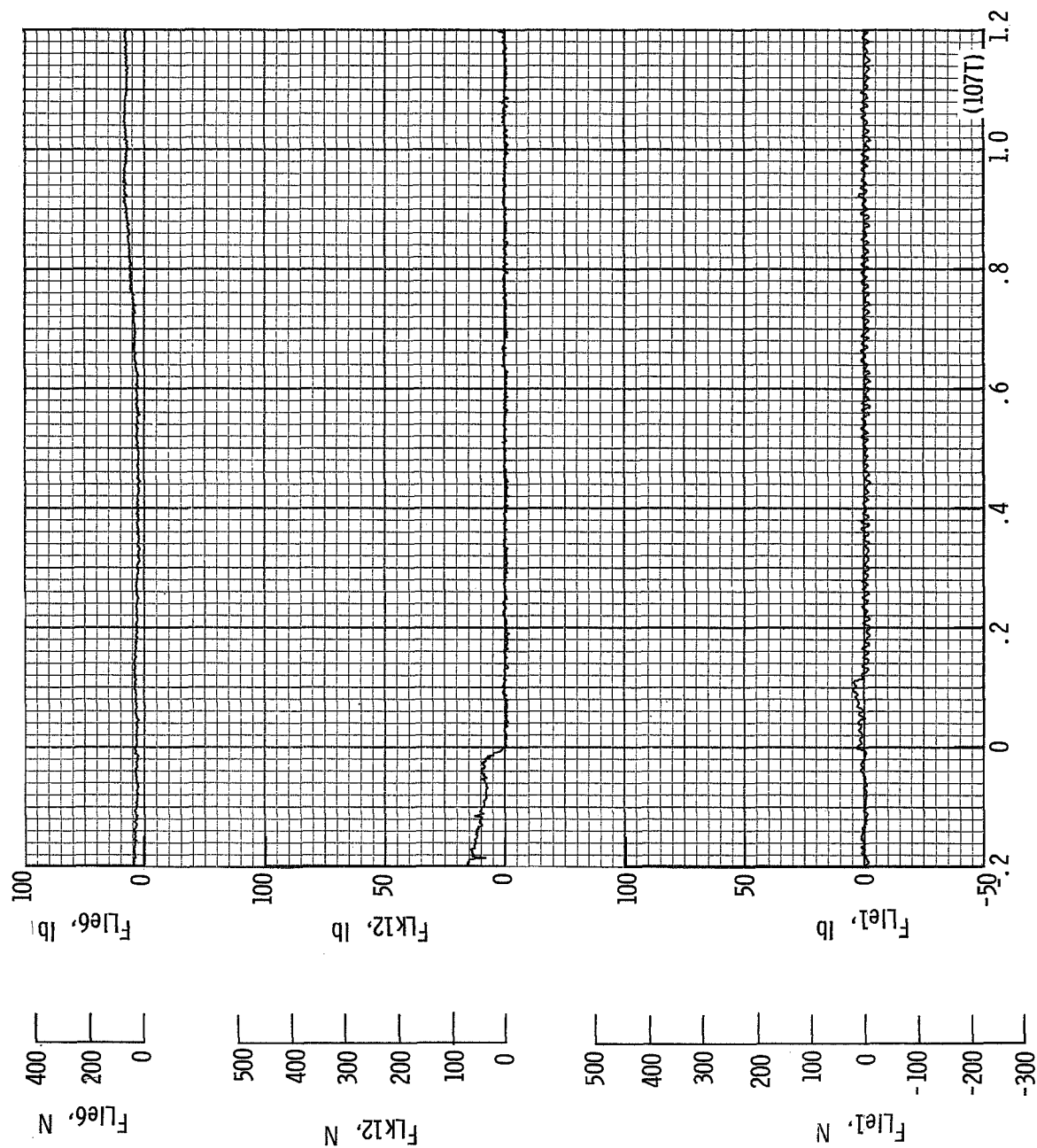
F_{Lk1} , N

300
200
100
0
-100
-200
-300



(u) Individual suspension-line loads F_{Lk1} , F_{Lle1} , and F_{Lle5} plotted against time from line transfer. Time = 0 second corresponds to 42.16 seconds after launch.

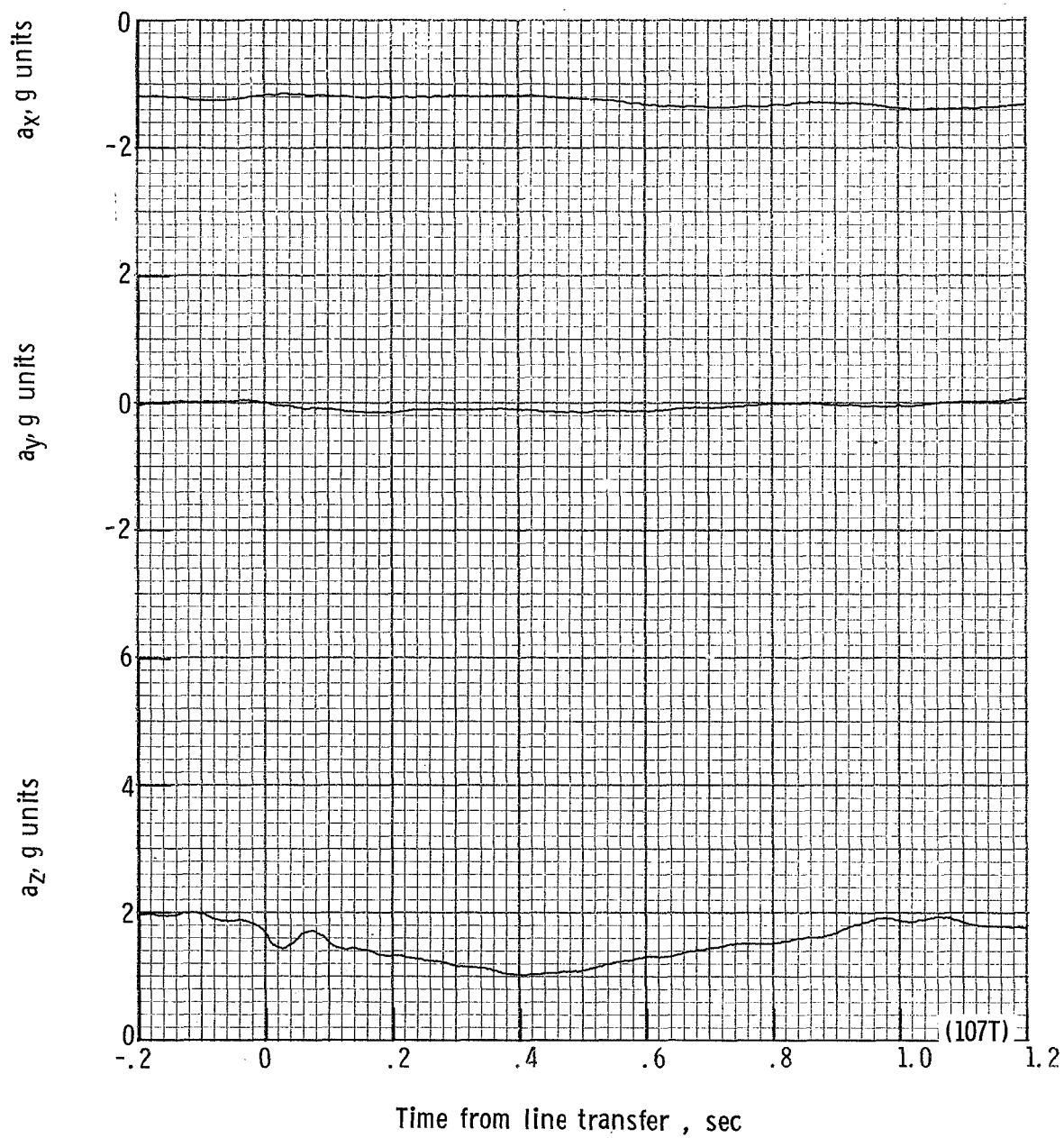
Figure 29.- Continued.



Time from line transfer, sec

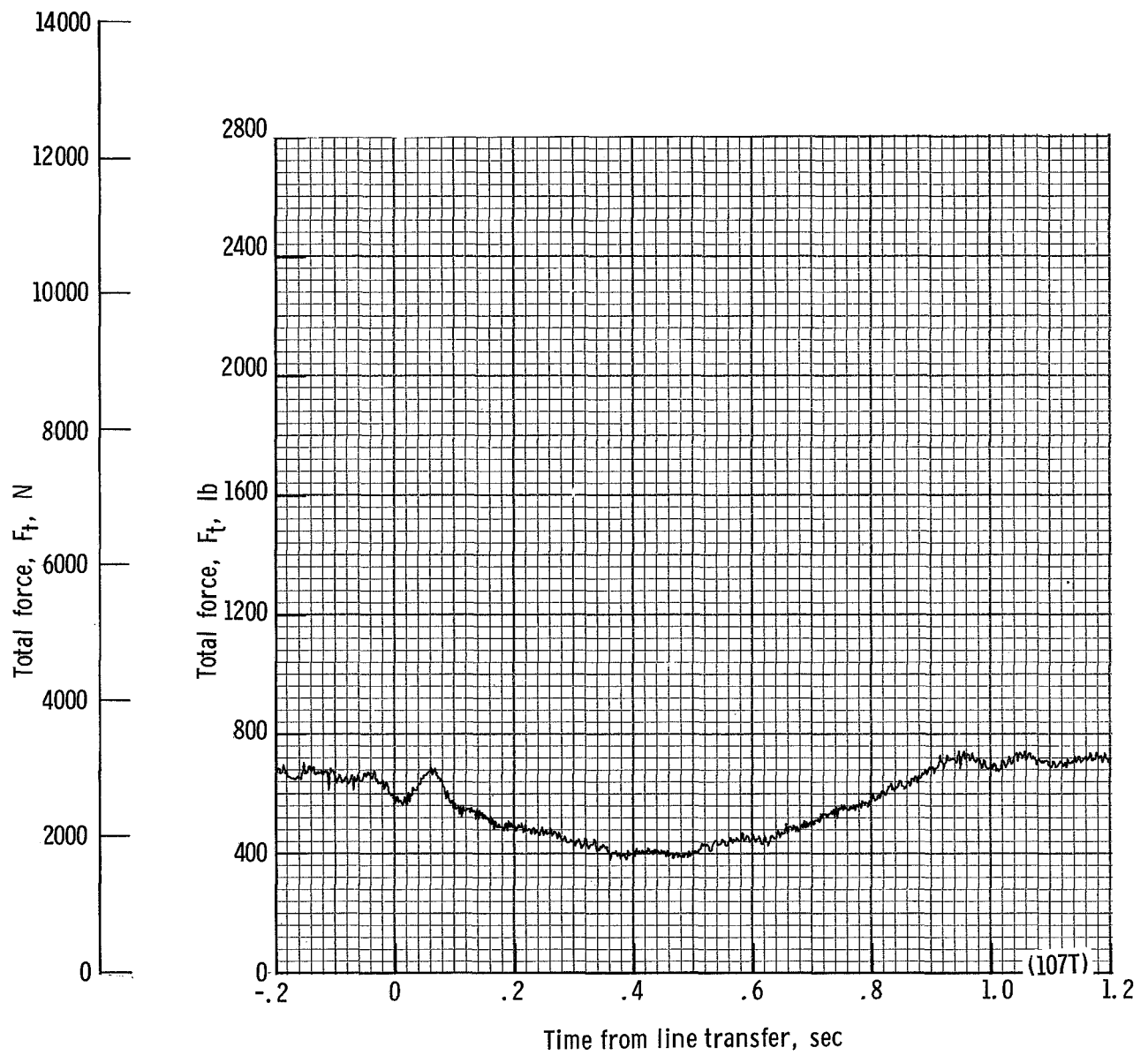
(v) Individual suspension-line loads F_{Lle1} , F_{LK12} , and F_{Lle6} plotted against time from line transfer. Time = 0 second corresponds to 42.16 seconds after launch.

Figure 29.- Continued.



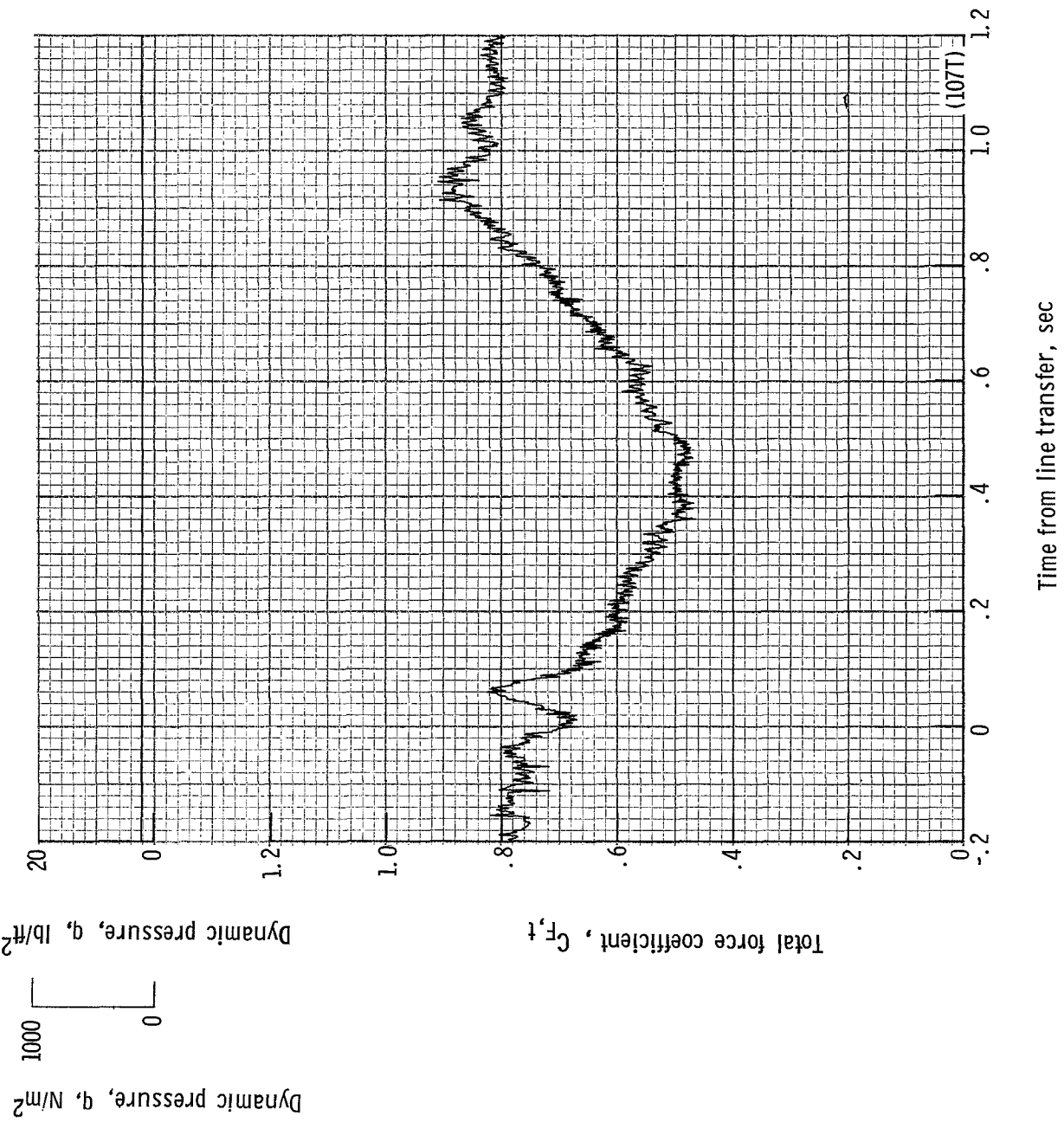
(w) Accelerations a_z , a_y , and a_x plotted against time from line transfer. Time = 0 second corresponds to 42.16 seconds after launch.

Figure 29.- Continued.



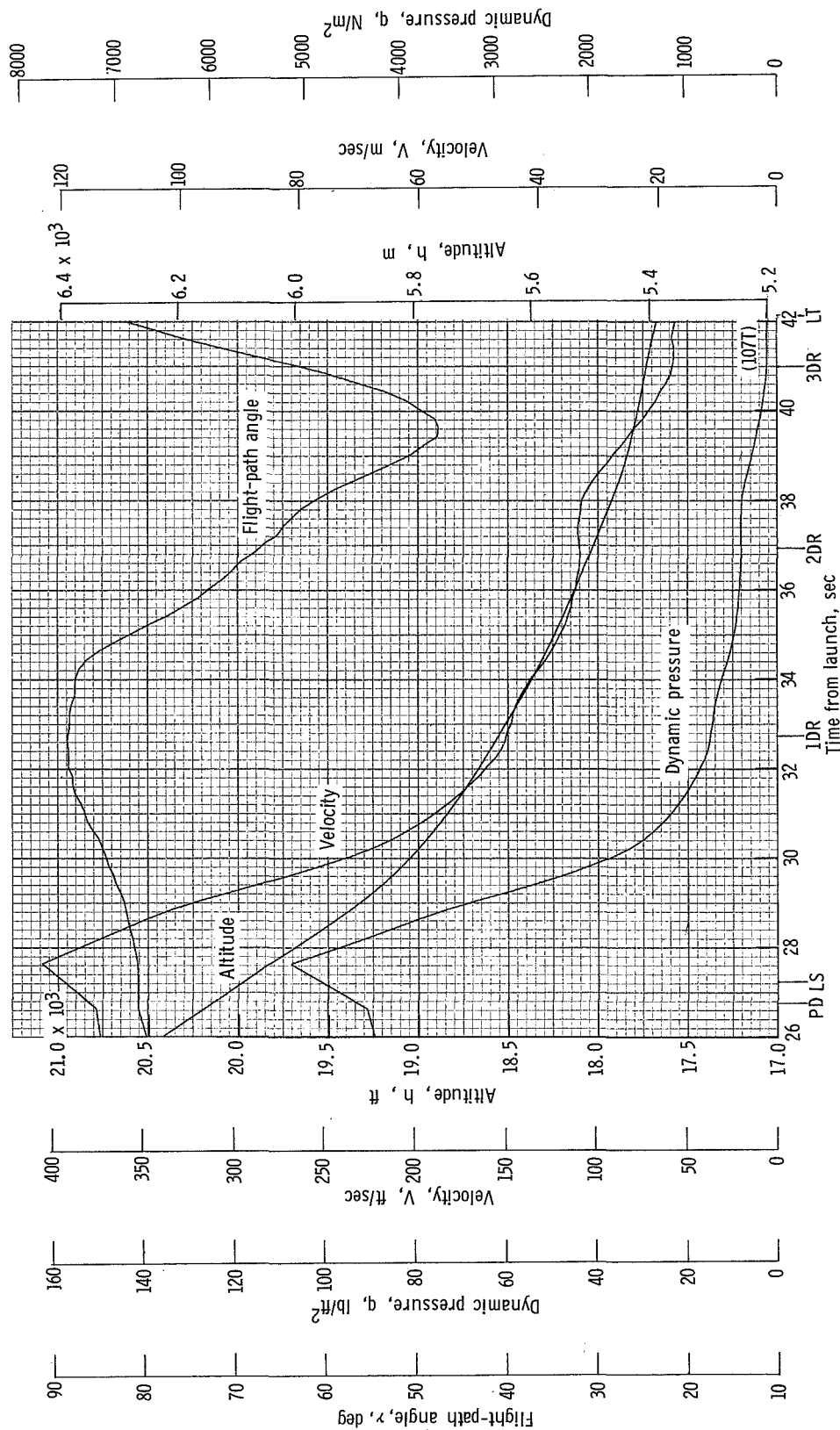
(x) Total force F_t plotted against time from line transfer. Time = 0 second corresponds to 42.16 seconds after launch.

Figure 29.- Continued.



(y) Total force coefficient $C_{F,t}$ and dynamic pressure q plotted against time from line transfer. Time = 0 second corresponds to 42.16 seconds after launch.

Figure 29.- Continued.



(z) Flight-path angle γ , dynamic pressure q , velocity V , and altitude h plotted against time from launch.

Figure 29.- Concluded.

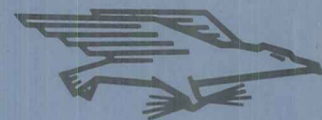
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